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Prelinguistic Communication Development in Infants and Toddlers with Cerebral Palsy: Guidelines for Assessment and Intervention

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Prelinguistic Communication Development in Infants and Toddlers with Cerebral Palsy: Guidelines for Assessment and Intervention

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Report

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Arts

The University of Texas at Austin

May 2013

Acknowledgements

I would like to express my gratitude to Dr. Barbara Davis for her encouragement and tremendous guidance throughout the process of this master's report. Furthermore, I would like to thank Dr. Dena Granof for her valuable editorial assistance and for her support throughout my graduate program. I would also like to thank Julie Foreman for inspiring my topic and for being a wonderful role model. Lastly, I am forever grateful for my friends and family, for their love and constant reassurance throughout this entire process.

Abstract

Prelinguistic Communication Development in Infants and Toddlers with Cerebral Palsy: Guidelines for Assessment and Intervention

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Children with cerebral palsy that have severe motor impairments, and often co-occurring visual impairments, may often have an impaired ability in prelinguistic forms of communication. In order for children to establish intentional communication, research suggests that prelinguistic communicative competence must be in place. Access to alternative and augmentative communication (AAC) is not sufficient to enhance interaction if motivation to communicate intentionally does not exist. The purpose of this literature review is to discuss the important aspects of early assessment and intervention for children with cerebral palsy who have severe motor impairment. There is a wealth of information about the development, assessment, and intervention of prelinguistic communication in typically developing children and children with developmental delays; however, limited empirical research focuses on children with severe physical impairments. The aim of this project will be to draw conclusions from the available research in order to formulate a protocol for speech-language pathologists to use in assessment and intervention of prelinguistic communication in young children with cerebral palsy.

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Chapter 1: Introduction

Children with cerebral palsy (CP) are at high risk for delayed or impaired expressive and receptive language development (Pennington, 2008; Rosetti, 2001). For individuals with severe motor impairment, intelligible oral speech communication may never be achieved (Pennington, Goldbart, & Marshall, 2005). The majority of current available research addresses intervention for communication disorders in children with CP that focuses on enhancing spoken or augmented output. Access to alternative and augmentative communication (AAC) is not sufficient to enhance interaction if the child has not developed the prerequisites needed for language output. Before intervention can focus on spoken or augmented expressive language output, children must first develop the intent to communicate. Typically developing children communicate intentionally with their caregivers through nonverbal communication including: eye contact and gaze, facial expressions, body movements or gesture, and vocalizations (Sandberg & Liliedahl, 2008; Siegel-Causey & Guess, 1989), long before they utter their first word. Communication delay and impairment in children with CP often begins in these earliest forms of intentional communication. A child must first develop these prelinguistic skills and establish intentionality before production of language output is achieved (Reinhartsen, 2000). A child with CP is at risk for delay or impairment in these early forms of prelinguistic communication due to impaired mobility, and possibly impaired perceptual system (Pennington, 2008). Early intervention to establish prelinguistic communicative competence is key to success in later language development.

Unfortunately, there is limited empirical research involving effective intervention for children with CP or severe motor impairments that addresses prelingusitic communication in the birth to three-year population. Clinicians must rely on clinical

expertise and the limited available research when making clinical decisions regarding best practices for assessment and intervention. The majority of available research involving the birth to three age group addresses typically developing children and other developmental disabilities, including autism. Using insight gained from the available literature, preliminary assumptions can be made regarding the development of pre-linguistic communication of children with CP. This report will investigate resources available for planning assessment and intervention for children with cerebral palsy accompanied by severe motor impairments that are functioning at or before the prelinguistic communication level. The outcome of this paper will provide a protocol for speech-language pathologists to use in early assessment and intervention of prelinguistic communication in children with cerebral palsy based on conclusions drawn from the available literature.

DEFINITION OF CEREBRAL PALSY

Cerebral palsy (CP) describes a group of disorders defined by a static, or non-progressive lesion that occurs in the developing fetal brain in utero, during delivery, or during the first two years of life (Cans, 2000). This cerebral insult leaves individuals with a permanent impairment of movement and posture (Miller, 2005; Rosenbaum et al., 2007; Cogher, Savage, & Smith, 1992). Thus, CP is an umbrella term for a group of disorders that can occur as a result of a variety of congenital, prenatal, neonatal and postnatal etiologies.

Congenital etiologies of CP refer to disruptions that occur in normal development, such as failures of normal brain formation, many of which have unrecognized genetic causes (Miller, 2005). Prenatal and neonatal causes of CP are often related to prematurity, which can lead to various injury patterns such as brain hemorrhages. Other prenatal

causes may be due to infections carried by the mother during pregnancy (e.g. rubella) (Miller, 2005). CP may also result from problems during the birthing process that involve hypoxic events, otherwise known as hypoxic-ischemic encephalopathy (HIE), usually in full-term infants (Martinez-Biarge, Diez-Sebastion, Rutherford, & Cowan, 2010; Miller, 2005). Postnatal causes of CP may include postnatal trauma, either from abuse or accidental traumatic brain injury, metabolic encephalopathy, infections, and toxicities (Miller, 2005). For the treatment of CP, it is much more valuable to classify children by specific neuromotor impairments than by the cause.

CLASSIFICATION

CP is traditionally classified according to the pattern of the affected limbs (i.e. hemiplegia, diplegia, quadriplegia) and the nature of tone or movement abnormality (i.e. spastic, ataxic, dyskinetic) (Cans, 2000; Cogher et al., 1992; Miller, 2005; O'Shea, 2008). Classification into hemiplegia refers to having half of the body affected; diplegia refers to the involvement of primarily the lower extremities with mild upper extremity involvement; and quadriplegia refers to impairment of all four limbs. Individuals may also be classified as triplegic, which refers to upper and lower extremity involvement that is much more severe on one side of the body than the other (Miller, 2005).

Spasticity is the most common movement abnormality in CP, characterized by increased muscle tone (hypertonia) marked as increased resistance to stretch and generally accompanied by hyperreflexia (Cans, 2000; Cogher et al., 1992; Buckley 1998; Paneth 2005). For example, a spastic arm initially resists being stretched but, after some point, stops resisting (Buckley 1998). Ataxic CP refers to the condition in which muscle tone is diminished (hypotonia) and ataxia (lack of balance) during volitional movement is present. Ataxia implies excessive incoordination of voluntary movement, which involves

difficulties regulating the force, range, direction, velocity and rhythm of muscle contractions. Dyskinesia refers to stereotyped, involuntary movements that are heightened with effort (Cans, 2000). It appears in two forms: dystonia and choreo-athetosis. Dystonia refers to fluctuating tone (usually normal or increased); choreo-athetosis, to irregular, spasmodic, involuntary movements of the limbs or facial muscles (O'Shea, 2008).

Table 1. Subtypes of cerebral palsy.

Classification of Cerebral Palsy	**Tone Abnormality**	**Description**
Spastic	Hypertonia	Increased resistance to passive movement; Tight, rigid muscles; Jerky movements; Increased deep tendon reflexes
Ataxic	Hypotonia	Decreased muscle tone; Lack of balance; Movements performed with abnormal force, rhythm and accuracy; Excessive incoordination of voluntary movement
Dyskinetic	Fluctuating	Stereotyped, involuntary movements that are accentuated with effort; Predominated by primitive reflexes; Excessive recruitment of inappropriate muscle groups during activity Dystonia: abnormal postures due to sustained muscle contractions and increased tone Athetosis: characterized by slow, writhing movement; decreased tone

Cans, 2000; Cogher et al., 1992; Paneth, 2008.

DIAGNOSIS

There is no consensus diagnostic criterion to diagnose CP in children. Premature diagnosis of CP in infants may be risky unless the child has severe and obvious disabilities. Birth history, persistent primitive reflexes, and deviations in normal

developmental milestones are usually the first signs of neurologic problems (Miller, 2005; O'Shea, 2008). MRI or CT scans may show abnormalities in an infant's brain, however not all children with mild or even severe forms of CP will show abnormalities on brain images (Miller, 2005; Paneth et al., 2006). While CP is defined as a non-progressive pathology, the clinical syndrome may change in an individual, due to maturation, development, and possibly repair (Cogher et al., 1992). A progression of clinical signs as a child develops is apparent in all types of CP, which makes early diagnosis difficult (Cogher et al., 1992). Because of an infant brain's neuroplasticity, children may occasionally outgrow their CP signs, and by the second or third year of life, may show little or no functional disability (Miller 2005; Cogher et al., 1992). For this reason, CP is often not diagnosed until at least 2 years of age for children who have more mild levels of involvement.

PREVALENCE

The prevalence of CP is estimated at about 3.3 per 1,000, or approximately 4% of 8-year-old children in the United States (Cans, 2000; CDC, 2013). With advancing technology, and the development and use of neonatal intensive care units, the survival rates of preterm and very low birth weight babies have increased (Paneth, Hong, Korzeniewski, 2006). Winter, Autry, Boyle, and Yeargin-Allsopp (2002) determined the prevalence of CP was 6.2 per 1,000 live births among children born weighing 1,500 to 2,499 grams (3⅓ to 5½ pounds) and 59.5 per 1,000 live births among children born weighing less than 1,500 grams.

COMMON COMORBIDITIES IN CEREBRAL PALSY

Individuals with CP often have several other neurologic disabilities that accompany the disorder. These include a high frequency of seizures or epilepsy,

cognitive impairment, learning difficulties, and perceptual disorders (Cogher et al., 1992; Martinez-Biarge, Diez-Sebastion, Rutherford, & Cowan, 2010). Additionally, muscle tone differences may cause a variety of health problems, including problems with feeding and swallowing, which could make it difficult for a child to get enough nutrition (Cogher et al., 1992). It is important to be cognizant of any existing comorbidities a child may have, their degree of severity, and how they may affect the child's development of communication and interactions with others.

Children with CP have a higher occurrence of visual impairment (approximately 48%) than that of typically developing children (approximately 4-5%) (Ghasia, Brunstrom, Gordon, & Tychsen, 2008; Cogher et al., 1992; Martinez-Biarge et al., 2010). Worse visual acuity is associated with increased levels of severity on the *Gross Motor Function Classification System* (*GMFCS*; Palisano, et al., 1997) (Ghasia et al., 2008). Children with the most severe CP, level 5, are at greatest risk for myopia (nearsightedness), absence of any fusion (both eyes used together), dyskinetic strabismus (one eye moving inward, or outward; crossed eyes), severe gaze dysfunction, and cortical visual impairment (CVI) (Ghasia et al., 2008). These deficits are rare, if not absent, in children with mild CP, or level 1 based on the GMFCS. Children with quadriplegic and mixed CP are more likely to have severe visual deficits than children with diplegic and spastic CP (Ghasia et al., 2008).

Hearing impairment occurs in approximately 30% to 40% of children with CP (Pellegrino, 2007). The cerebral lesion that resulted in the child's impaired motor system may simultaneously damage the cochlea, resulting in sensorineural hearing impairment (Pellegrino, 2007). Significant hearing impairment is common in quadriplegic CP, and particularly in athetoid or dyskinetic CP (Cogher et al., 2005).

Cognitive impairment has been estimated to occur in about 30% to 50% of children with CP, and is most prevalent and severe in children with spastic quadriplegia subtype (Pruitt & Tsai, 2009). Cognitive impairment may range from severe global intellectual impairment, to mild or specific learning difficulties (Cogher et al., 2005). It is important to note that impairment or delay in language skills, along with co-occurring perceptual impairment can lead to false underestimation of intelligence.

FUNCTIONAL OUTCOMES OF CEREBRAL PALSY

Cerebral palsy is a broad term, with a wide range of functional impairment; hence the impact on an individual with CP's quality of life varies greatly. Infants are often termed "at risk for being nonspeaking" if they meet the following criteria: 1) Prematurity, birth anoxia, or prenatal conditions considered to be high risk factors. 2) Feeding difficulties or persistent oral/motor control problems. 3) Delayed onset of vocalizations and/or speech relative to same-age peers. 4) Evidence of any neuromotor deficits that may be related to speech development (McDonald, 1980). The World Health Organization (WHO) endorses the International Classification of Functioning, Disability and Health (ICF)'s conceptual framework for classifying the spectrum of an individual's functioning. This framework is based on a model of disability that recognizes that functional abilities are not only dependent on intrinsic aspects of the medical condition, but the limitations it places on an individual's activity and participation (WHO, 2001). The ICF's framework is composed of two parts, termed "body structures and functions" and "activity and participation." The "body structures and functions" component of the ICF framework focuses on the integrity of the body parts required to function. In the case of children with CP, the injury of the brain would be the example of body structure, whereas impairments of body functioning may include severe motor impairment, visual

impairment, etc. The second component, termed activity and participation, includes the various activities that a person does as a part of their everyday life (e.g. drinking from a cup), and the various roles the child partakes in (e.g. communication, relationships with others).

The focus of this paper is on the impact that severe motor impairment has on the development of communication abilities in children with CP. In other words, how does the level of body function affect the child's level of activities and participation? In order to describe the impact that motor and perceptual impairment has on the development of prelinguistic communication in this population, the motor and communication development in typically developing children is outlined as a background.

Chapter 2: Review of Developmental Milestones

MOTOR DEVELOPMENT

Early communication signals of children with CP are often inconsistent and difficult to produce due to the nature of impairment in movement and posture. Prelinguistic forms of communication include: eye gaze, fine motor acts such as pointing, gross motor acts such as head turning, vocalizations, gesture, and facial expressions (Sandberg & Liliedahl, 2008; Siegel-Causey & Guess,1989). Motor movement is involved in each of these prelinguistic behaviors. Deficits in this area of development place children with severe motor impairment at high risk for delay or impairment in the acquisition of prelinguistic communication. If present, these communication signals are often unusual and idiosyncratic due to motor differences in the child's profile of capacities, making it difficult for caregivers to interpret and respond appropriately. In addition, the emergence of new motor skills changes infants' experience with objects and people in ways that contribute indirectly to the development of communication (Iverson, 2010). The following section will outline how motor movement develops in typically developing children, and how these movements contribute directly and indirectly to the development of communication. This will provide a foundation for understanding the impact that motor impairment has on the development of prelinguistic communication in young children with CP.

Typical motor development

Early motor development from birth to three provides a foundation for future communication development (Iverson, 2010). Three basic elements of motor activity, "tone", "control", and "strength" are the basis for the functions of movement, posture, balance, and coordination (Buckley, 1983). The brain sends orders to contract or relax the

muscles to perform these motor movements. Beginning at birth, motor development follows a generally predictable, sequential cephalocaudal (head-to-foot) progression (Buckley, 1983; Lamb 2002). For example, the visual system reaches anatomical maturity earlier than do the legs; sight reaches maturity earlier than locomotion. The mastery of body control begins with the head, and then proceeds to the arms, torso, and finally the legs (Buckley, 1983). This is demonstrated by the early development of the neck and shoulder muscles, allowing for head control months before an infant has control of their lower body. Motor development also proceeds proximo-distally from the center of the body outward (Lamb, 2002). Coordination of the neck, shoulders, and torso precedes coordination of arms, fingers, and legs (Buckley, 1983). The motor system has a hierarchical development, with control of the large muscles (gross motor) generally appearing before children are efficient in using the small muscles (fine motor). The sequence and coordination of motor development depend on both physical maturation and experience (Haywood & Getchell, 2009).

Typically developing infants are born with a set of specific automatic patterned motor responses, or reflexes, that determine an infant's response to stimuli. Infant reflexes help meet a child's most basic needs, until the motor system develops sufficiently to provide voluntary control (Buckley, 1983; Haywood & Getchell, 2009). These unlearned, primitive reflexes are generated by the lower brain centers (Lamb, 2002). With maturation, higher cortical processes begin to generate voluntary motor activity, and reflexes that do not support the voluntary activity are inhibited (Buckley, 1983). The presence, absence, or existence of normal and abnormal reflexes is an excellent indicator of early neurological development (Buckley, 1983; Haywood & Getchell, 2009). Below is a list of primitive and automatic reflexes in typically developing children.

Table 2. Overview of reflexes in typically developing children.

Reflex	Type	Description	Age Emerging	Age Disappearing
Moro (Startle Reflex)	Primitive	Head extended backward results in arms embracing.	Birth	3 to 5 months
Asymmetric Tonic Neck Reflex (ATNR)	Primitive	Head turned to side elicits "fencer's position."	Birth	3 to 5 months
Tonic Labyrinthine	Primitive	Supine with head back elicits extension of body; prone with head forward elicits flexion.	Birth	1 to 3 months
Landau	Late-Primitive	Active raising of head when in prone position elicits "skydiver's" position: (extension of body).	6 months	2 years
Tonic Neck Reflex (TNR)	Late-Primitive	On hands and knees, head back elicits arms extending and hips flexing; held down, elicits reverse.	6 months	9 months
Head-Righting Reflex	Automatic	When body is tilted or upside-down, head attempts an upright position.	1 month	Integrates
Derotative Reaction	Automatic	When one part of body rotates out of line, rest of body follows to achieve realignment.	4 to 6 months	Integrates
Protective Reflexes	Automatic	Rapid severe changes in body position result in movement of limbs to "break the fall."	4 months	Integrates
Equilibrium Reflexes	Automatic	Mild changes in position result in movement of body to maintain a given posture.	4 months	Integrates

Buckley, 1983; Haywood & Getchell, 2009.

Typically developing children follow a generally predictable sequence of gross and fine motor development. Gross motor skills are the activities that involve the use of the larger muscles and are necessary to accomplish daily tasks as well as language learning. An important early milestone of gross motor development is typically met at 2

months of age, when the child has developed the ability to support and lift their head (Haywood & Getchell, 2009). A child will continue to develop the gross motor skills to sit unsupported, crawl, and eventually walk by 15 months of age (Haywood & Getchell, 2009).

Fine motor skills involve the use of the small muscles of the body in precise activities such as pointing and grasping. Fine motor development is hierarchical, simple skills develop separately and then become elaborated and more complex. Throughout the first 12 months of life, an infant will progress from an inefficient type of raking grasp, to the eventual pincer (thumb and index finger) grasp (Buckley, 1983). By six years of age, typically developing children have the ability to print the alphabet (Buckley, 1983).

Maturation of motor skills provides infants with opportunities to act on their environment. The development of motor skills contributes directly and indirectly to the development of language (Iverson & Goldin-Meadow, 2005). Motor development directly contributes, and is imperative for oral speech; however, availability of articulatory abilities is not sufficient for language development (Iverson, 2010). According to the dynamic systems theory of development (Thelen, 2005), growth in one sphere of life will have impact on others; psychomotor development affects multiple aspects of psychological growth (Lamb, 2002). Table 3 summarizes motor milestones in typically developing children.

Table 3. Typical motor developmental milestones.

Motor skill	Average Age at Attainment
Reflexive, uncoordinated movement	Newborn
Side-to-side head turn	1 month
Raises head when on stomach	1-2 months
Supports head	3 months
Swipes at object	1-3 months
Brings hands to mouth	1-3 months
Raises head and chest when lying on stomach	3 months
Rolls over	4 months
Grasps objects purposefully	5 months
Transfers objects from hand to hand	6-8 months
Sits without support	7 months
Uses pincer (thumb and first finger) grasp	8 months
Hands-&-knees crawling	9 months
Pulls up to a stand	9 months
Standing without support	9 months
Walks without assistance	12-15 months

Buckley 1983; Centers for Disease Control and Prevention (CDC), 2013; Miller, 2005.

Motor development in cerebral palsy

The hallmark characteristic of cerebral palsy is atypical motor development. Due to the neurological damage caused to the infant brain, impairments in muscle tone, posture, and the coordination of movement will result in atypical motor development. Early motor delay in gross motor skills (e.g., rolling, sitting, crawling, ambulating or running) with or without concurrently affected fine motor skills (e.g., grasping, transferring, manipulating, stacking, scribbling or copying) is apparent in infants and toddlers with CP (Shevell, 2010). The development of motor milestones will vary for each child with CP. Because the initial injury is to the infant brain, development over time will often bring changes to the child's motor development (Miller, 2005). In previous sections the tone and posture of children with different subtypes of CP were

discussed. Within these subtypes, the development of motor abilities may vary greatly for each child. Therefore, general differences in motor development are discussed.

As TD children grow, early primitive reflexes disappear. Hyperreflexia is most commonly associated with CP, characterized by the presence of primitive reflexes well after the age of which they should disappear (Cans, 2000; Cogher et al., 1992; Buckley 1998; Paneth 2005). Persistent reflexes greatly interfere with the development of a child's gross and fine motor skills. For example, the presence of the asymmetrical tonic neck reflex (ATNR) is often seen in children with spastic quadriplegic CP (Cogher et al., 1992). Turning the child's head activates this reflex; the side to which the child's face turns will cause the arm and leg to extend in the same direction. While this reflex in the 4-week-old infant promotes visual fixation on the hand (beginning eye-hand coordination), it may serve to interfere with voluntary posture and head control in a 9-month old child (Buckley, 1983). A child who persists in primitive reflexes may be unable to perform a variety of gross and fine motor movements.

One of the earliest signs of motor abnormalities is hypotonia or low muscle tone, which is often apparent in the newborn child with CP (Paneth, 2008). Hypotonia may negatively affect the development of motor milestones often seen in TD children, such as head control, independent sitting, etc. Children with hypertonia may also be negatively affected in their motor development. For example, some babies with CP may have hypertonia to a degree where attempts at movement may cause extensor thrusting (Cogher et al., 1992). This may be exhibited when a baby smiles in response to the sight of a face, which causes the baby's whole body to exhibit an extensor pattern, causing the head to tip back, the eyes to roll upwards, and thus losing visual contact with the original stimulus. In turn, interpretation of child's communication signals may be negatively affected by atypical motor development. What originally was a behavior signifying

pleasure may have been interpreted as rejection because of the child's reflexive movement.

In sum, motor development in infants and toddlers with CP may vary depending by the tone, posture, presences of reflexes, and limbs affected. The *Gross Motor Function Classification System- Expanded and Revised* (*GMFCS-E&R*; Palisano, R., Rosenbaum, P., Bartlett, D., & Livingstone, M. G. E., 2009), displayed in the Appendix, is commonly used to describe the severity of motor impairment in children with CP on a scale of I-V.

COMMUNICATION DEVELOPMENT

Typically developing children communicate with their caregivers through facial expressions, gestures, eye gaze, and vocalization long before they speak their first word. Children with severe disabilities also develop prelingustic communication, but their communication forms may be idiosyncratic and difficult to interpret (Chen, Klein, & Haney, 2007). There is a critical need for research demonstrating effective early communication strategies for children with severe and multiple disabilities. Information derived from studies of prelinguistic communication development in typically developing infants is particularly relevant for children with severely delayed communication. Looking at how and why prelinguistic communication develops in typically developing children will contribute to understanding the development of prelinguistic communication in children with CP. The development of control over motor behavior makes possible the expression of intentional communication. For example, the inability for a child to physically lift his arm or hand to point towards a distant object of interest is limiting the child's ability to learn how his own actions can have an effect on the actions of others. The development of intentionality drives the acquisition of language (Romski, Sevcik, Hyatt, & Cheslock, 2002). The following section illustrates how early

communication develops in typically developing children, and more importantly, how motor development contributes directly and indirectly to the development of prelinguistic communication. A thorough understanding of the development of prelinguistic communication (or the impairment in) is necessary in order to provide appropriate assessment and effective intervention for young children with CP.

Stages of typical communication development

Communication is an act of transferring a message from a speaker to a listener (Halle & Meadan, 2007). It is characterized by reciprocity, where intentionality and understanding of the partner's thoughts and intentions are important for successful transfer of a message. In order for communication to be effective, the speaker's communicative intention must be the same as the communicative function interpreted by the listener (Halle & Meadan, 2007).

The social act of communication is a dynamic process that begins at birth. A typically developing infant begins this process by gaining prelinguistic communicative competence. Prelinguistic communicative competence refers to a number of skills and behaviors that are prerequisites to the development of language (whether it be verbal, signed, or augmented) (Reinhartsen, 2000). These prelinguistic behaviors develop throughout the first 12 months of life in typically developing children (Reilly et al., 2006). If effective communication is defined as a listener correctly interpreting a speaker's communicative intention, it implies that the speaker has developed intentionality.

Bates, Camaioni, and Volterra (1975) describe the development of intentionality in three stages: perlocutionary, illocutionary, and locutionary. Prior to the development of intentional communication, infants engage in communicative behaviors that are primarily

reflexive and non- purposeful (Reinhartsen, 2000). These acts are not goal-directed and are driven by an infant's internal needs (e.g. crying when a child is hungry), or in response to external events (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). An infant who reacts to an auditory or visual stimulus by turning his head is responding to external events in their environment. This pre-intentional stage is defined as the perlocutionary stage of development (Bates et al., 1975). During this stage of development, caregivers have the primary responsibility for assigning communicative meaning (Romski et al., 2002). The caregiver interprets rudimentary behaviors such as crying and eye gaze as an indication of a desire to initiate, maintain, or terminate an interaction, and responds to them as though they were intentional (Reinhartsen, 2000; Romski et al., 2002). As caregivers respond to these behaviors in contingent, consistent, and predictable ways, the infant's previously unintentional communication acts are reinforced. The adult's response to an infant's unintentional signals establishes a means-end relationship that is the first step in the development of intentionality (Bates et al., 1975).

Beginning around nine months of age, an infant moves from the perlocutionary (pre-intentional) to the illocutionary (intentional) stage of development (Bates et al., 1979). During the illocutionary stage, an infant is aware of the effect that a signal will have on his listener. The infant may persist in a behavior until the goal is reached, or failure is clearly indicated (Bates et al., 1979). The following are indicators of intentionality in infants: (1) alternating eye contact between the goal and the intended listener, (2) persistence in the behavior until the goal is obtained, (3) changes in the form of the signal until the goal is obtained, (4) using a signal that is ritualized or has conventions that are recognized by the listener, (5) waiting expectantly for a response

from the listener, (6) terminating the signal when the goal is achieved (Bates et al., 1979; Wetherby, Cain, Yonclas, & Walker, 1988).

Infants in the illocutionary stage of development use intentional communication for a variety of functions. Bruner (1981) identified three broad communicative functions: behavior regulation, joint attention, and social interaction. An infant may communicate in order to request or reject an object/action (i.e. behavior regulation) (Bates et al., 1975; Bruner, 1981). For example, a child may turn his head in rejection of an undesired food item, or reach his arms up in order to indicate wanting to be held. Social interaction includes social routines and games, attention seeking, and greetings (Bruner, 1981). Joint attention is used to request information, comment, or direct the listener's attention in the form of showing (Bruner, 1981; Ogletree, Wetherby, & Westling, 1992). During the illocutionary stage, the child has not yet developed symbolic communication, and will use a variety of nonsymbolic, prelinguistic forms of communication to express the communicative functions mentioned above. Prelinguistic forms of communication include facial expressions, gestures, body movements, postures, touch, vocalizations, and eye contact (Siegal-Causey & Guess, 1989). Prelinguistic communicative competence is needed before a child can progress to the locutionary stage of symbolic communication (Bates et al., 1975).

Children with CP are at risk for delayed or impaired development of symbolic communication (Cress, Arens, & Zajicek, 2007), due to delays or impairments in the development of prelinguistic communication. Prelinguistic communication in the form of joint attention, turn-taking, gesture, and vocalizations are discussed in the framework of typical development as well as their development in the child with CP.

Typical development of joint attention

Earliest forms of prelingustic skills are presented in the form of eye gaze and joint attention (Crais, Douglas, & Campbell, 2004; Reinhartsen, 2000). Joint attention is defined as a state in which the attention of a child and a communication partner is coordinated, focusing on the same object or activity (Bakeman & Adamson, 1984; Cress et al., 2007; White et al., 2011). Joint attention is critical to the development of intentional preverbal communication and is highly correlated with the development of later language skills (Cress et al., 2007; Reinhartsen, 2000). Through joint attention and eye gaze, infants are able to act intentionally on their communication partners, drawing their focus and influencing their partner's behavior.

Caregivers and infants utilize eye gaze as a means of inferring attentional focus before the emergence of deictic gestures (Crais et al., 2004). Caregivers will follow the infant's line of regard as a means of monitoring the infant's focus of attention (Crais et al., 2004). Infants engage in joint attention beginning at birth in primarily face-to-face interactions with their caregivers (Bigelow, 2003). As an infant matures, gaze behavior increases in complexity. An infant progresses from dyadic joint attention (2-point gaze shift), gazing at a single person or object, to coordinated or triadic joint attention, involving 3-point gaze shifts between people and objects (Bakeman & Adamson 1984; Cress et al., 2007; Mundy & Willoughby 1998; Mundy 2010).

From one to two months of age, infants often attend to faces and fixate on eyes (Reinhartsen, 2000). At approximately three months of age, infants discover that their caregiver's faces are responsive, and convey affect. A caregiver's facial expressions serve to gain the infant's attention and become means of initiating early communication signals (Reinhartsen, 2000). Face to face social interaction with others is at its height during this time, as infants are visually fascinated by their partners (Bigelow, 2003).

Around four to five months of age, infants become increasingly attentive to objects and show less awareness of their partner's participation in the play (Bigelow, 2003; Mundy & Willoughby, 1998). By six to nine months of age, typically developing infants become increasingly capable of sharing experience about objects and events by directing or following the visual gaze of social partners (Bigelow, 2003; Reinhartsen, 2000;Mundy & Jarrold, 2010). Around this age, there is an important shift from dyadic to triadic, or referential communicative interactions (Mundy & Willoughby, 1998). Triadic joint attention expands to incorporate attention to both partner and an object or event (Mundy & Jarrold, 2010; Mundy & Willoughby, 1998). The ability to use triadic joint attention indicates that the child can appreciate that others have perceptions and intentions relative to objects or events and that these can be affected by the child's behaviors (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998).

Joint attention behaviors fall into two main categories; responding to joint attention (RJA) and initiating joint attention (IJA) (Mundy & Jarrold, 2010). Responding to joint attention (RJA) refers to the infants' ability to follow the direction of the gaze and gestures of others in order to share a common point of reference. RJA functions as a reaction to the potential that others' gaze signifies an important source of information in the environment (Mundy & Jarrold, 2010). Joint attention is foundational to the development of language, learning, and social skills (Mundy & Jarrold, 2010; White et al., 2011). Infants use RJA to correctly associate their parents' vocal labels to the correct distal object or event in the midst of an environment full of potential referents (Baldwin, 1995). Alternatively, initiating joint attention (IJA) refers to the infants' behavior that directs a caregiver's attention to objects, to events, and to themselves. The classical function of IJA is to "show", the act of seeking to share interests or pleasurable experience with others (Mundy & Jarrold, 2010). Using IJA, infants are able to denote

something of immediate interest to their caregiver. Parents are then able to provide new information in context when the child's interest is focused on the object of their attention, which is the optimal moment for learning. Table 4 summarizes the development of joint attention and eye gaze in TD infants.

Table 4. Joint attention milestones in typically developing children.

Behavior	**Average Age at Attainment**
Attends to faces and fixates on eyes	Birth-3 months
Turns head toward sound	1-2 months
Visually tracks moving objects	3 months
Recognizes objects and people at a distance	3 months
Imitates smile	3 months
Smiles spontaneously, especially at people	4 months
Vocalizes in response/babbles	6 months
Follows adult's gaze	6 months
Shifts attention between object and adult	6-9 months
Child follows an adult's point	10-12 months
Child points	12-14 months

Bigelow, 2003; CDC, 2013; Reinhartsen, 2000

Development of joint attention in children with cerebral palsy

It is known that a high percentage of children diagnosed with CP will have co-occurring visual impairment (Pruitt & Tsi, 2009). An infant with CP is at risk for delays and impairment in the development of joint attention due to disturbances in muscle tone, posture, and visual differences. Caregivers often have difficulty assessing where the child's attention is focused, making it difficult to respond to the child's bids for JA. A child's inability to explore and manipulate objects may also negatively affect triadic joint

attention. Important findings from available research on the development of joint attention in children with developmental delay (DD), including infants with CP and other neurological impairments are discussed.

Children with CP often develop joint attention problems during the late infancy period (i.e. between 6-24 months) during the shift from dyadic to triadic joint attention (Arens, Cress, & Marvin, 2005). Arens et al. (2005) investigated joint engagement behaviors of 25 pre-intentional children aged 9-25 months with diagnosed developmental disabilities (12 of which had a diagnosis of CP) during unstructured play activities with their caregivers. The authors hypothesized that impairment in joint attention was related to the child's limited head control, which restricts the child's ability to shift eye gaze between the objects of their attention, and a social partner, otherwise referred to as triadic joint attention. The aim of this study was to observe what kinds of JA behaviors expected for typically developing infants are produced by pre-intentional children with DD. Secondly, the authors questioned whether the children with DD who had better motor skills showed more gaze shift behavior than those with more limited motor skills. Third, they examined whether pre-intentional children with DD who have lower overall cognitive scores show less gaze-shift behavior than children with higher cognitive scores.

Results of Arens et al.'s (2005) study showed that on an average, the children with DD spent more than half of their observed time with their parent unengaged. The majority of the child's engagement was directed towards objects or to people in two-point gaze shifts. Children were seldom observed using coordinated triadic joint attention. Motor skills such as head control had a large impact on the ability of the children to coordinate gaze shifting (Arens et al., 2005). Shifting of the head and eyes between persons or objects in different positions or visual fields was found to be an added difficulty for the children with DD. Typically developing children in Bakeman and

Adamson's (1984) study, who were at similar developmental ages to the children in Arens et al. (2005) overall showed significantly higher reports of gaze towards objects. Arens et al. (2005) observed a low occurrence of parents holding objects in the child's field of vision, providing little support or direct prompts to look at objects. This may have contributed to differences found in a child with DD's eye gaze towards objects (Arens et al., 2005). Motor delays that impair the child's ability to grasp and inspect objects themselves may also hinder the child's development of joint attention involving objects.

Children with CP are less likely to initiate eye contact (i.e. IJA) with parents than typically developing peers (Hanzlik, 1990). This may be influenced by the child's difficulty in shifting positions and grasping objects, making them more restricted to the activity that is presented by the parent. For example, a child may shift his or her attention to an object on the floor while seated upright in a highchair. Because of poor head control, children may be delayed in their ability to shift their attention back to an adult. Even if the child successfully returns eye gaze to the adult, the time delay between the two may cause the child to miss the opportunity for joint attention. This may result in tendency for children to remain unengaged, as was observed in Arens et al.'s (2005) study. Children with DD spent relatively little time observing (watching the parent do something) or engaged in passive joint attention (both parties engaged in the same object) when compared to TD children in Bakeman and Adamson's (1984) study. Arens et al. (2005) noted that parents of children with DD did not socially engage their children very often when the child was involved with objects, which may have contributed to the decreased amount of time involved in passive joint attention. The time in which the child was coded for gaze towards an object was an opportunity for the parent to establish joint attention. Arens et al. (2005) also noted that parents were observed to respond and play

jointly with an object more readily when the child initiated interest in the toy (IJA) rather than simply watching the toy the parent was engaged in.

Children with cortical visual impairments tend to have difficulty focusing visual events for more than a brief glance, although a child may still be attending to an event using peripheral vision (Arens et al., 2005). Arens et al. (2005) note a limitation of their study was that children were coded as unengaged when observers were unable to discern if a child was looking at something. The child's visual impairment may negatively affect a partner's ability to understand where the child's focus is. The authors also acknowledge that the child's positioning during parent-child play may have influenced the relative ease with which children shifted their gaze between objects and parents. For example, if parents are seated behind a child, the child with motor impairment is unable to turn their head to find the parent and engage in joint attention. There is a possibility that the children with DD in this study showed fewer three-point gaze shifts than they were cognitively capable of producing due to motor and positioning limitations. Two-point gaze shifts require limited head and visual control such as a single movement to readjust the child's gaze orientation, suggesting that the children in this study were able to establish simple forms of JA.

Yoder and Farran (1986) studied joint attention patterns of infants with neurological damage and their caregivers. They were compared to TD children. Two frequent behavior patterns that interrupted triadic joint attention with a caregiver were observed. The most frequent interruption in joint attention was with the activation of a reflex pattern. The second most frequently observed behavior that interrupted JA was unfocused gaze. Both behaviors made sustaining attention to an object with their mothers very difficult. It is important to note that these two behavior patterns are both involuntary behaviors that are a result of the child's neurological damage. The most common reason

for interrupted joint attention in the TD children was to attend to a new object of interest (Yoder & Farran, 1986). Mothers of the TD infants were more likely to follow the child's shift in focus of attention, than that of the handicapped infant (Yoder & Farran, 1986).

Typical development of gesture

The ability to signal one's intentions is highly predictive of higher-level communication development in children with disabilities (Brady, Marquis, Fleming, & McLean, 2004). One important means of prelingustic communication that a child uses to signal intent is through gesture. Gestures are one of the most consistent early indicators of intentionality, providing a means for a child to communicate information before they develop oral speech and language (Iverson & Goldin-Meadow, 2005). Gestures can be expressed using the fingers, hands, and arms, and may also include facial features and body motions (Crais et al., 2004; Iverson & Thal, 1998). Impairment in voluntary gross and fine motor movements, as occurs in CP, will directly affect a child's ability to produce gestures. The development of gestures in TD children and how it relates to the development of intentional communication is discussed. This will aid in the understanding of the relationship between impaired gesture development in children with CP and the development of intentional communication.

Typically developing children produce their first gestures between 7 and 9 months of age (Crais et al., 2004; Iverson & Goldin-Meadow, 2005). Gestures can be divided into two primary categories: deictic and representational (Crais, Watson, & Baranek, 2009). Deictic gestures, including showing, giving, and pointing, establish reference by calling attention to or indicating an object or event (Bates, 1979; Iverson & Thal, 1998; Reinhartsen, 2000). Deictic gestures consist of both contact and distal gestures (Bates et

al., 1975). Contact gestures require contact between a child and object or caregiver, and are considered the earliest forms of gestures. Contact gestures typically develop at approximately 8-9 months of age (Crais et al, 2004). They include grabbing, showing, giving, and pushing in refusal. Showing behaviors appear before giving (Crais et al., 2004). For example, an early show behavior may involve a child playing with an object, followed by holding the object out towards an adult with no intention of relinquishing it. This behavior eventually evolves into showing and giving objects the child is not already manipulating. Around 11 months of age, children develop distal gestures, those that require no contact with the caregiver or object (Crais et al., 2004; Bates et al., 1975). Distal gestures include pointing, waving, and reaching. The earliest deictic gestures often appear as open-handed reaching, reaching to be picked up, and pushing in refusal (Crais et al., 2004). Both contact and distal gestures can only be interpreted by the context in which they are used. Transition from contact to distal gesture may be related to the symbol acquisition process (Crais et al., 2004).

Deictic gestures may be proto-imperatives (behavior regulation function, requesting object or action) or proto-declaratives (joint attention function, drawing attention to object) (Bates 1975; Bruner, Crais, Douglas, & Campbell 2004; Reinhartsen 2000). Proto-imperatives appear at around 9 months of age and function to engage the adult as a tool for obtaining a desired object (Iverson & Thal, 1998). Following the development of proto-imperatives, a child establishes the function of indicating an object with the goal of gaining the adult's attention, known as proto-declaratives. (Iverson & Thal, 1998). This is a means of initiating interactions with an adult.

Representational gestures appear around 12 months of age, and are used to reference and indicate a particular semantic content (Iverson & Thal, 1998; Crais et al., 2004; Reinhartsen, 2000; Crais et al., 2009). According to Iverson and Thal's (1998)

categorization, there are two types of representational gestures: object-related and conventional. Object-related or "symbolic" gestures can represent semantics (cupping your hand for drink). Object-related gestures represent some aspect of a referent and can be produced either with our without the referent object in hand (Crais et al., 2004). Empty-handed gestures may be used for communicative purposes whereas "referent-in-hand" gestures are primarily a kind of naming. Children use referent-in-hand gestures to recognize, identify, or categorize objects as members of a known class (e.g. "drinking" when given a cup) (Crais et al., 2004). Conventional gestures (waving bye, finger to lips for hush) often appear around 12 months of age, and are used as social markers, representing some action or concept rather than a specific object (Crais et al., 2004; Crais et al., 2009).

Research observing gesture development in TD children has found that gestural ability can provide predictive evidence of later spoken-language levels. The development of gestures moves from deictic gestures to the use of representational gestures, showing a gradual distancing of self from object that indicates symbolic development (Capone & McGregor, 2004).

Gesture development in children with cerebral palsy

Whereas gestures have been identified as one of the most consistent and early indicators of intentionality in TD children, development of gestures in children with CP may differ greatly. Depending on the nature of the child's physical impairment and visual capacities, development of intentional gestures (e.g. reaching, pointing, etc.) may or may not be within the child's capabilities. Impairment in the timing and planning of coordinated gross and fine motor movement may often result in inconsistent gestures that

are difficult to interpret. Due to the presence of primitive, or atypical reflexes, gestures may be counterintuitive or unintentional at times.

Abnormal patterns of movement may interfere with a child's expression of intent through gesture. A child who has difficulty controlling voluntary movements, or who has differences in tone and posture, affecting the way in which movement is produced, may produce movements that are counterintuitive or unconventional. For example, due to the presence of the asymmetric tonic neck reflex (ATNR), a child who turns his head to the side will also extend his arm in the direction that the head turns (Cogher et al., 1992). What appears to be "reaching" is actually an involuntary movement. On the other hand, a child who attempts to gesture in the form of reaching may result in producing involuntary movements such as head turn; thereby losing visual contact with person or object it was intended for. Hence, interpreting the intent of the gesture may be difficult.

Overall, the development and nature of gestures in CP differs greatly from those observable in TD children. There is no current literature explaining the course of gesture development in children with CP. Movement patterns in CP vary from child to child; therefore, gestures will be different for each. It is important to understand the child's specific movement patterns in order to develop a profile of gestures, and establish whether or not they are intentional, so that meanings can be assigned.

Parent-child interaction

An infant with CP may often produce communicative signals that are unconventional or difficult for caregivers to interpret (Cress, Moskal, & Hoffman, 2008). In turn, parents have difficulty responding appropriately to their child's behaviors, making interactions difficult to establish and maintain. Contingent responses are defined as behaviors that are contextually related to a child's communicative behavior, and are

provided immediately following the child's signal (Yoder & Warren, 1998). Contingent responses from a child's communicative partner are crucial to the development of intentionality. Breakdowns in these early interaction patterns between the child with CP and his or her communication partner may result in a less responsive communication style. This communication pattern may, over time, restrict the child's development of important social, cognitive, and communicative skills that are imperative for the development of intentional communication. Typical parent-child interaction, in particular, caregiver contingency or responsivity, is discussed in comparison to the interaction style often observed in research of young children with CP and their caregivers.

Contingent parent responses can help a child recognize that his or her behaviors have an effect on the environment, establishing the child's understanding of a means-end relationship, as well as intentional and symbolic communication (Harwood, Warren, & Yoder, 2002). Contingent responses also aid in the development of joint reference and labeling skills, enabling the child to process the communicative information received from a parent's linguistic input (Yoder & Warren, 1998; Cress et al., 2008). Maternal responses that are not only contingent, but also consistent in terms of the same interpretation of and the same response to the infant's signal over time will provide the infant with predictable feedback and support the development of intentionality. Consistency is also required on the part of the infant. In typically developing infants, behaviors that are consistent begin to elicit predictable responses from caregivers. Predictability allows infants to learn from previous experience how caregivers might respond to specific signals, which sets the stage for the development of intentional behaviors. By approximately 8 to 9 months of age, typically developing infants begin to use consistent, intentional, signals to communicate with caregivers (Bruner, 1981;

Reinhartsen, 2000). Current research examining parent-child interaction of TD children has associated high parent responsivity with expanded language development by the 2nd year of life (Tomasello & Farrar, 1986).

Another aspect of parent-child interaction shown to be supportive of language development is the degree of parent directiveness. Directiveness refers to noncontingent parental prescriptions of attention or action that are not in line with the child's focus of attention (Cress et al., 2008). During early typical development, parents take on a more directive role during interaction with their infant. However, as the child reaches 18 months of age, parents become less directive and exhibit less control during interactions (Cress et al., 2008). Current research examining the interaction patterns of children with CP and their caregivers has observed differences in the parent-child interaction when compared to interaction patterns of TD children and their caregivers.

Parents of children with physical impairment have been reported to exhibit more directive behavior during interactions than parents of TD children (Hanzlik, 1990; Pennington & McConachie, 1999; Sandberg & Liliedahl, 2008). Several studies have suggested degree of physical and/or cognitive impairment in children is negatively associated with parent responsivity and contingent interaction, and positively associated with parent directiveness (Hanzlik & Stevenson, 1986; Slonims, Cox, & McConachie, 2006). Mothers of children with CP are observed to be more verbally and physically directive (Reinhartsen, 2000), which may be in response to the child's difficulty in initiating communication signals, or even the caregiver's inability to read and appropriately respond to their signals. Children with CP are often placed in respondent roles during conversations, have fewer turns, and are more compliant to parent directives. This pattern of interaction is a natural result of a child that is slow to initiate, has

inconsistent and unconventional communication signals, and is often slow to respond when it is their turn.

Turn-taking patterns of caregivers and their TD children often differs from those of children with disabilities. Mothers of children with CP have been shown to take significantly more turns during interactions with their child than mothers with TD children (Pennington & McConachie, 1999). This may be due to the lack of sufficient time the parent allows for the child to respond, or the child may simply ignore their turn. Examining the interaction patterns of parents and their children with visual impairment has important implications for understanding the interaction patterns of children with CP. A child with significant visual impairment, which is often the case for a child with CP, may lack normal eye contact or sustained gaze behaviors, which makes it difficult for a caregiver to judge whether or not the child is attending to or interested in the interaction (Rattray & Zeedyk, 2005). This may hinder reciprocal interaction patterns if a parent ceases an activity if they believe a child is not attending or is disinterested. Infants with visual impairment may have difficulties in perceiving how their partner's attention and emotional reactions are directed (Hobson 1990). For example, without visual reinforcement of a mother's smile for an infant's smiling behavior, this behavior may diminish. With a lack of visual reinforcement, this behavior diminished over time. Therefore, alternative modalities, other than visual reinforcement, are needed during interaction with visually impaired children (Bigelow, 2003). This finding has important implications for intervention targeting caregiver responsivity for children with CP, which is discussed in later sections. Communication is a reciprocal interaction; the behavior of the parent constantly influences that of the child, and vice versa.

CONCLUSION OF DEVELOPMENTAL MILESTONES

The development of prelinguistic communication in children with CP is greatly affected by the child's motor abilities, and/or any co-occuring impairment in vision, hearing, and cognition. The development of motor, perceptual, and prelinguistic skills in TD children has been outlined in order to understand how children with CP may differ. Current research has recognized differing patterns in joint attention, eye gaze, gesture, and caregiver-child interaction in children with CP. A child's motor and perceptual abilities greatly affects the coordination of eye gaze and joint attention, as well as the production of consistent and conventional gestures and vocalizations. As a result, caregivers often find it difficult to read and follow the child's communicative signals, and often take on a more directive role during interactions. Therefore, the child with CP is at risk for delay or impairment in the development of intentional prelinguistic communication.

Chapter 3: Assessment

INTRODUCTION

Development of prelinguistic behaviors in both typically developing and children with CP has been outlined. The ways in which these behaviors can be assessed is discussed in this chapter. The goal of assessment is to generate a clear, reliable, and representative description of a child's communicative behaviors that could be useful for developing appropriate intervention. The need to "diagnose" is less important than the need to assess and identify children who possess or who are at risk of developing communicative delay or impairment. The impact that physical and perceptual impairments associated with the disability have on the child's ability to communicate may vary depending on each child. With the ICF's framework in mind, the goal of assessment does not involve simply identifying a disorder at the level of body structures and function (WHO, 2001). More importantly, activity limitations and participation restrictions must be identified and addressed as a part of clinical management.

Assessing infants and toddlers with CP can be challenging due to limited availability of tools designed for use in assessment of prelinguistic communication in children with physical and perceptual impairments whose communicative behaviors may be idiosyncratic and inconsistent. The purpose of this section is not to focus attention toward any specific assessment tool. Rather, the goal is to assist therapists in forming an overall philosophy of assessment. The focus of assessment is on the child, the communication partner, and the environment (Snell & Loncke, 2002).

GUIDELINES FOR ASSESSING THE CHILD WITH CEREBRAL PALSY

Specific to infants and toddlers with CP, important areas of assessment include cognitive, emotional, motor, perception, and communication. Given the influence that

these areas of development have in relationship to the development of communication, assessment of children with CP should be a collaborative effort among a variety of professionals (Beukelman & Mirenda, 1998). Team members may include, but are not limited to: speech-language pathologist (SLP), occupational therapist (OT), physical therapist (PT), audiologist, psychologist, neurologist, pediatrician, teachers, family members, and most importantly, caregivers (Linder, 1990). A trans-disciplinary approach to assessment and intervention allows multiple team members to view the child and discuss how deficits observed may be interrelated (Linder, 1990). Assessment should include all members of the team in a collaborative effort, allowing sharing and integration of expertise of the team members.

Research addressing assessment of communication behaviors in the birth-three population, in particular, young children with autism and other developmental disabilities (DD), has used a combination of different means to assess the prelinguistic communication abilities of this population (Halle & Meadan, 2007). Caregiver interviews, formal and informal assessment measures, and observations of caregiver-child interaction will all be discussed in length as they pertain to infants and toddlers with CP.

Caregiver Interview

The first step in the assessment process is obtaining information about the child, his communication partners, and his environment through interview of the parent, caregivers, and other potential team members. Parents and caregivers know their child the best, and information they provide is crucial considering the limited sample of behavior that is obtained during a one to two-hour assessment. The goal of the interview process is to gather information about the child's current communication system. During

the interview process, information regarding the following areas should be gathered: the child's communication behaviors including expressive and receptive skills, repair strategies, routines or familiar activities, reinforcers/ child preferences, problem behaviors, current intervention strategies, and any strategies the partner uses to promote communication (including the child's environment). It is important to interview multiple communication partners in order to assess how the child's communication may vary with different partners, and to uncover any contradictions (Snell & Loncke, 2002).

Parent interview should be performed prior to the assessment of the child, if possible, in order to allow the clinician to plan assessment activities. Information obtained during the interview may allow the clinician to construct hypotheses about the child. By asking the right questions, the partner's perception of the child's communication abilities may be influenced. For example, asking about daily routines such as meals, grooming, play, and bedtime rituals is likely to increase the partner's impression that their child is communicating in some way, expanding their understanding of what communication behaviors their child is producing (Snell & Loncke, 2002). The goal of the parent interview is to formulate a detailed description of the child's communicative behaviors, and in what contexts they occur. Information obtained from the interview should allow the clinician to predict what routines may be observed, what will be rewarding or tempting for the child, and what communication may be expected. This information will be valuable when planning dynamic assessment.

Assessment of motor and perceptual abilities

Given that CP is a disorder of movement and posture, assessment of children with CP should begin with an observation of the child's motor abilities. It is within the SLP's scope of practice to assess motor abilities, however a diagnosis and formal classification

of motor impairment requires collaboration with or referral to a physical therapist or physician. The most widely used classification system of motor impairment in CP is *the Gross Motor Function Classification System- Expanded and Revised* (*GMFCS-E&R*; Palisano et al., 2009). While this system classifies the child's motor impairment on a scale of I-V in severity, it is beyond the SLP's scope of practice to diagnose or classify a child's motor impairment.

The purpose of an SLP in assessing motor abilities is not to formulate a diagnosis of motor impairment, but instead to describe the child's motor abilities so that the clinician can have a better understanding of how the child's motor development may affect the development of communication and/or language. As previously noted, children with severe motor impairment are at high risk for delays and impairments in the development of communication (Rosetti, 2001). In order to provide intervention that supports the child's development of communication, it is important to understand the child's current movement capabilities. Several current standardized assessment measures for infants and toddlers include motor checklists and inventories. Appendix contains a list of assessment measures containing motor scales used by speech-language pathologists.

Children with CP are likely to have co-occurring perceptual impairment, including vision and hearing (Cogher et al., 1992; Martinez-Biarge, Diez-Sebastion, Rutherford, & Cowan, 2010). Awareness and understanding of the child's perceptual abilities is important when assessing, as well as providing intervention for a child with CP. Collaboration among other professionals such as physicians, audiologists, and ophthalmologists will allow a clinician to be able to fully understand the child's capabilities. This team approach will allow the clinician to make adjustments according to the child's abilities during assessment. For example, a child with known visual

impairment will need to have objects and people within their visual field in order to interact effectively.

Assessment of communication abilities

Caution is needed when formally assessing communication abilities of young children with CP. While widely used in clinical practice to assess and diagnose communication disorders, formal measures may have limited use with children where there are no valid norms. Although many assessment measures may be adjusted to use with children with severe motor impairment, there are very few formal assessment measures that were created for the sole purpose of assessing the communication abilities of this population. However, many researchers have formulated structured protocols for evaluating the communicative behaviors of children with severe and multiple disabilities in their empirical studies. The following section aims to provide clinicians with the information needed in order to understand how formal measures (including standardized instruments, checklists, and research protocols) can used to assess communication abilities young children with CP.

Communication assessment measures

There are many limitations to using formal measures when assessing children with CP, however a competent assessor can induce a marginally effective assessment instrument to work for them. Formal measures include both criterion and norm referenced tests. A test is simply a means of structuring observations and reporting results. When assessing infants and toddlers with CP, the proficiency of the assessor is much more critical than the test that is used (Rosetti, 2001). The goal of assessment is to formulate a complete picture of the child's strengths and weaknesses. Caution should be used when selecting an appropriate assessment tool.

Norm-referenced tests

A norm-referenced test (NRT) is one that allows the examiner the opportunity to interpret how an individual's performance compares with that of a referent group in which the test was normed. These norms often do not include children with motor or perceptual impairments (Cogher, 1992). Standard scores and percentile ranks are obtained, that correspond to locations on a normal distribution (Manjnemer, 2006). In addition to these scores, developmental age scores (DA) are often found. Test items must be administered in a narrowly prescribed fashion, allowing for a similarly narrow group of acceptable responses in order for the test scores to be considered valid for the intended purposes of the test (Cogher, 1992). An examiner is able to determine how far a child falls within the typical range of a specific behavior under these narrow conditions. A large disadvantage of using NRT tests with the CP population is that the examiner must often ignore a child's behavior because it does not fit the protocol afforded by a particular assessment. Examiners will often widen the group of acceptable responses in order to accommodate the child with motor or perceptual disabilities (Rosetti, 2001). Hence, many examiners do not use NRTs as they were intended, which devalues the major, if not the only, strength of external validity of the test (Snell & Loncke, 2002). Thus, NRT is not the most reliable assessment measure to use with young children with CP.

Criterion-referenced tests

Criterion referenced tests (CRT) are more common tools to use when assessing young children with CP (Manjemer, 2006). A CRT functions as a developmental profile or checklist of skills that indicate mastery of particular domains under investigation (Rosetti, 2001). The benefit of using CRT versus NRT with young children with CP is that the administration of test items is typically non-standardized. Thus, the examiner is allowed to illicit desired behaviors in whatever manner possible. This latitude is

particularly beneficial when assessing any population involving young children, as often a child's behavior can be unpredictable, especially in an unfamiliar setting. The one to two hour time period that a clinician often has to assess a child may not always produce the best sample of a child's behavior. Hence, behaviors documented on CRTs may be observed by the examiner or through parent report. A CRT provides an overall indication of performance and is more likely to reflect progress than a NRT. A NRT will not reflect change unless a sufficient number of items are achieved to obtain a difference in overall score (Rosetti, 2001). These tests are not norm-referenced; therefore the child's performance is not compared to other children (Rosetti, 2001).

Limitations of formal assessment measures

Although widely used, there are many limitations to using formal measures to describe the communication abilities of young children with CP. Often these tests do not yield a score (whether a standard score, developmental age, etc.) that describes an individual's overall level of pre-symbolic or early symbolic communication development (Brady et al., 2012). Most of these measures focus on a limited set of behaviors, in particular visual attending skills and communicative gestures. These behaviors may not be present in children with CP who have severe motor impairment or visual impairment. Children with visual impairment may rely on touch, vocalization, and facial orientation to convey focused attention (Rattray & Zeedyk, 2005). It is also important to consider individuals with severe disabilities that may be too old to use the normative scales, although they may be functioning at a developmental level well below their chronological age.

One of the most significant disadvantages to using formal measures in a population with motor impairment is the reliance of many test items on motoric responses, even when motor skills are not being directly assessed. Some of these

measures, such as the *Battelle Developmental Inventory (BDI-2;* Newborg, 2005), provide strategies for modifying the test to accommodate children with motor impairment in their test manual. For example, the manual asks the examiner to note the degree of the child's head and trunk control, and to position the child to maximize functioning. In addition, the manual tells the examiner to be aware of "clues" that a child may use to make a response (i.e. eye gaze, gesture, body movement). When using formal measures, a child who has difficulty coordinating movement will need additional time on tasks to coordinate a response. Adaptive strategies such as pointing to items and saying, "Is this the one?" are suggested to use with children with severe motor impairment. This is assuming of course that the child has the means to communicate yes/no or express choice.

Another caution to consider when administering formal measures to young children with CP is the possibility of vision impairment. Many of the tests, for example the *BDI-2* (Newborg, 2005), provide adaptive strategies in their manual for children with vision impairment. These include environmental adaptations such as lighting, positioning of test items, magnifiers, etc. Allowing time for tactile exploration of test items is also suggested. Appendix A displays formal assessment measures often used to assess early communication skills of children with CP.

Research Protocols

In order to foster intentional communication development, it is important to monitor the child's communicative signals and to respond consistently across situations. An inventory of the child's communicative signals may allow a variety of caregivers to understand the communicative behaviors of the child and the functions that they serve. A child's signals may be grouped by communicative function (e.g. requesting, protesting) or form (e.g. eye gaze, vocalization, etc.). Several researchers have formulated structured

protocols for the purpose of assessing the forms and functions of pre-linguistic communicative behaviors in children with CP and other disabilities. These protocols may prove valuable to clinicians, as they provide a structured way of describing the various communicative behaviors that children with CP may use. Many of these protocols are in the form of questionnaires to be filled out by caregivers, or by clinicians during direct observation.

Many standardized assessments include similar parent questionnaires in their protocols, and are listed in Appendix A. These checklists and questionnaires provide a standardized way of gathering information about a child based on the typical pre-linguistic milestones observed in typically developing children. For example, a commonly used infant communication checklist is found in the *Communication and Symbolic Behavior Scales-Developmental Profile (CSBS-DP): Infant Toddler Checklist* (Wetherby & Prizant, 2002). A parent fills out a questionnaire that asks about a child's emotion and eye gaze, communication, gestures, and sounds, rating them on a scale of occurrence.

While checklists may be helpful for a clinician to identify a level at which the child is functioning, it has little use in describing the communication abilities of the child. A more descriptive list of the forms and functions that the child is using to communicate would allow the clinician to understand the behaviors that the child is currently producing. The following section will discuss the structured protocols researchers have formulated for the use of describing prelinguistic communication abilities in young children with multiple disabilities.

Sigafoos et al. (2000) developed the *Inventory of Potential Communicative acts (*IPCA) a questionnaire designed to be completed by caregivers, teachers, and other team members working children with developmental and physical disabilities, accompanied by

severe communication impairment. The purpose of the interview is to gather descriptive information on any behaviors that the child produces that are interpreted by others as communicative. The inventory consists of 53 questions that describe 10 distinct communicative functions. Instead of using the term "prelinguistic" or "presymbolic" communication, the authors propose the term *potential communicative act (PCA)*. Their term identifies the possibility that the child's existing behaviors, whether informal or idiosyncratic, might have potential of becoming intentional and effective means of communication.

The *IPCA* was derived from an assessment tool published by Donnellan, Mirenda, Mesaros, and Fassbender (1984). Donnellan et al.'s (1984) interview protocol asked the adult to identify any of the following behaviors the child may use including: (a) eye gaze; (b) vocalizations; (c) facial expressions (smiling, frowning); (d) body movements (wiggle, kick); (e) hyperventilation; or (f) other. The original format asked the informant to identify which communicative functions the behaviors served (i.e., greeting? Request?). Sigafoos et al. (2000) identified limitations of the original approach, mainly that the assessment did not sufficiently describe the communication forms and functions that the individual communicated as they related to specific contexts. The authors noted that this information was crucial in order to plan intervention programs.

In Sigafoos et al.'s (2000) study, the *IPCA* was expanded to address these limitations. This interview differs from the questionnaires and checklists found in assessment measures listed in Appendix A. The *IPCA* focuses on the communication forms and functions observed in children with DD, physical impairment (PI), and severe communication impairment (SCI), as opposed to only TD children. The research sample used for the development of the expanded IPCA consisted of 20 children with DD/PI and SCI that varied in a range of developmental and physical disabilities. Four children with

severe physical disabilities ages 16-38 months associated with cerebral palsy were among the group. The *IPCA* was administered in interview format instead of a questionnaire, in order to gather more descriptive information. Information obtained from the interview is recorded on a summary form and transferred to a scoring grid that allows one to obtain a visual overview of the child's range of communicative forms and functions. One of the advantages of using a summary of the child's communicative behaviors as apposed to a checklist, is that the knowledge of a child's abilities are documented so that they can be shared with other team members and communication partners. Sharing of this information is valuable due to the idiosyncratic nature of the population's behaviors and the difficulty that unfamiliar partners may have at interpreting the behaviors. A summary of the child's behaviors in specific contexts will allow unfamiliar communication partners to respond appropriately to the child's communicative acts, providing consistency and preventing extinction of positive behaviors.

Using a measure such as the *IPCA* would ensure consistency in recognition of, interpretation of, and response to a child's PCAs across settings and activities. Multiple communication partners are able to participate in the *IPCA* interview. The benefit of having multiple partners provide a summary will uncover discrepancies that may reflect real differences in the child's use of PCAs. Structured assessment opportunities can be used to verify the behaviors described in the protocol.

Halle and Meadan (2007) have described a structured protocol for assessing request, reject, and repair behavior of young children with autism spectrum disorders and other developmental disabilities. The authors describe request and reject behaviors as means of behavior regulation. The authors propose that children with ASD and DD who have limited intentional communicative behaviors often communicate mainly for the

purpose of behavior regulation. The behaviors of these children are often unconventional, making them difficult to interpret, often producing breakdowns in communication.

The purpose of their protocol is to develop a clear and reliable description of a child's communication abilities to plan appropriate intervention. The protocol consists of three steps: (1) Assessing the child's preferences through interview, (2) Building rapport with the child, (3) Assessment using a structured protocol that provides opportunities for requests, rejects, and repairs. This approach to constructing assessment focuses on the individual abilities of the child that is being assessed, as compared to protocols based on typically developing children. The importance of this protocol in view of assessment of children with CP is that it is sensitive to the child's current developmental level. The authors describe their protocol as unique in that it individualizes the protocol for each child. The protocol aims to optimize the assessment context to produce the best communicative performance possible.

The assessment measure consists of a scripted protocol, providing the examiner a step-by-step procedure of how to use the child's preferred items and activities to provide opportunities for request, reject, and repair. The examiner records the behaviors of the child on an individualized coding sheet broken down into: type of item, type of response, type of activity, initial topography or behavior (i.e. head nod, vocalization, etc.), breakdown, and repair topography. The benefit of using a structured protocol such as this one is the ease at which it may be adapted for intervention. By providing a summary of the child's topographies, those that are easily interpreted or conventional may identified, reinforced, and possibly expanded. A summary of the child's behaviors and their functions will, again, allow multiple communication partners the opportunity to respond consistently to the child's behaviors.

Dynamic Assessment

Young children with CP require more flexible, individualized assessment approaches than merely administering standardized assessment measures. In order to gain the best sample of a child's communicative abilities, assessment approaches should involve those that do not place the child in a primarily respondent role, or that rely on information gathered at a single point in time (Snell & Loncke, 2002). Observing the child's spontaneous communication would be ideal. However, due to the variability of a child's behavior, spontaneous communication may be too infrequent to thoroughly depict the child's entire range of skills. Dynamic assessment is an example of a flexible approach to assessment for children with CP.

Dynamic assessment is based on a test-teach-test model of assessment (Snell & Loncke, 2002). The child is first observed communicating without support from the examiner, and then the examiner introduces a prompt over a trial or series of trials. Changes in the child's behavior are recorded if present. Finally, the child is reintroduced to the previous task without assistance to see whether learning has occurred. A benefit to dynamic assessment for a child with CP is that it does not compare the child's communication abilities with that of others of the same chronological or developmental age. A majority of the available assessment measures have been normed on typically developing children who do not have motor and sensory impairments. As was discussed earlier, the development of communication abilities in children with CP differs greatly from that of typically developing children.

Dynamic assessment is based on Vygotsky's (1986) zone of proximal development proposal. According to his perspective, assessment procedures should identify the current status of the child's maturing functions through dynamic, interactive procedures in order to provide indications for estimating the extent of their development.

By assessing a child's current state of development, insight can be provided as to what the child needs to develop. The zone of proximal development refers to the functions a child is able to use in interaction, but not yet independently (Chaiklin, 2003; Vygotsky, 1986). Therefore, through dynamic assessment, successful assisted performance is used as an indicator of the child's zone of proximal development, in other words, the child's potential performance.

Caregiver-child interaction

Caregivers play an important role in the development of a child's intentional communication (Chen et al., 2007). As discussed in previous sections, providing contingent responses to a child's communicative behaviors fosters the development of intentional communication. Communication signals of children with CP are often difficult for caregivers to read, which negatively affects caregiver responsiveness and the development of turn taking skills (Buckley, 1983). Research examining caregiver-child interaction patterns of children with CP and severe motor impairment has reported increased directiveness of parents during interactions with their disabled child (Pennington & McConachie, 1999). Researchers have often observed children with CP to initiate less, taking on a more respondent role during interactions (Pennington & McConachie, 1999). Therefore, an important part of the assessment process involves observation of the child interacting with the caregiver, as well as other communicative partners. The goal of observing the child's behavior during natural interaction with a caregiver is to gather information about the child's communication abilities, the partner's communication, and the environmental facilitators and barriers (Snell & Loncke, 2002). There are few formal assessment measures that document parent-child interaction styles.

For this reason, it is important to understand how to identify positive interaction styles that support the child's communication development.

Current literature focusing on caregiver training provides mostly informal means of assessing caregiver-child interaction. In Cress, Grabast, and Jerke's (2013) study examining contingent interactions between parents and young children with severe expressive communication impairments, looked specifically at the functions and modes used by both partners during natural play samples. Many researchers have developed specific coding schemes to use in their studies that observe parent-child interaction styles. Arens et al. (2005) developed a coding scheme to assess parent-child interaction that consisted of seven categories of child engagement: unengaged, onlooking, with persons, with objects, and three types of joint attention, passive joint, two-point gaze shifts, and coordinated three-point gaze shifts. The information provided in their research study provides valuable information for assessing children with CP that may have co-occurring visual impairments. Arens et al. (2005) also discuss the importance of awareness of the child's motor differences. For example, the presence of atypical reflexes and poor head control may negatively impact the parent's perception of where their child's attention is focused. In Snell & Loncke's (2002) manual for dynamic assessment, the authors provide readers a step-by-step guide of how to structure and analyze an observation of parent-child interaction.

A child with CP may produce signals that are often misinterpreted or not acknowledged at all. If the intent of a child's communication signal is continuously misread, eventually the intent to communicate may decrease because of a lack of reciprocity. This is the basic principle behind Seligman's (1975) theory of learned helplessness (As cited in Basil, 1992). In order to prevent this pattern of learned

passivity, and to support the child's communicative competence, assessment of the status of caregiver-child interaction pattern is needed.

ASSESSMENT CONCLUSION

The goal of assessment is to understand the child's current level of communicative abilities, the partner's reactions and support of these abilities, aspects of the child's environment that hinder or support communication development, and to establish a plan for intervention. Important areas to consider when assessing a child with CP include the appropriateness of assessment measures and adaptations needed according to his/her motor and perceptual abilities. Caution is needed when using formal assessment measures, and the use of informal and descriptive measures have been recommended. Collaboration among caregivers and other professionals is important when assessing infants and toddlers who have multiple disabilities. Children with CP require more flexible, individualized assessment approaches that do not rely on comparison to TD children of the same chronological or developmental age. Obtaining the most accurate and comprehensive picture of a child's communicative abilities is key. In particular effective assessment approaches include those that do not (a) place the child primarily in a respondent role, (b) rely on information gathered at a single point in time from a single communication partner, or (c) gather data only on spontaneous communication which may be too infrequent (Snell & Loncke, 2002).

Chapter 4: Intervention

INTRODUCTION

In order to develop effective communication interventions for children with CP who function at the prelinguistic or preintentional level, the outcome of intervention must be defined. Olson and Granlund (2003) define the desired outcomes of intervention for presymbolic communicators within the framework of the World Health Organization (2001). According to the ICF's framework, intervention can target the following dimensions: (1) body function and structure, (2) activity, (3) participation, and (4) the environment (i.e. factors that serve as facilitators or barriers to the child's development). Although communication intervention for children with severe physical impairment could target body functions, the primary focus should be to intervene with limitations in the areas of activity, participation, and the environment (Olson & Granlund, 2003).

The need for early intervention for children with CP is central given the negative effects that physical and perceptual impairments will have on the acquisition of intentional communication. Young children with CP have diverse range of impairments and communication profiles, making early intervention for this population uniquely challenging. Many children with physical disabilities may never acquire oral speech, and therefore, direct intervention is needed in order to acquire alternative formal modes of communication (Tait, Sigafoos, Woodyatt, O'Reilly, & Lancioni, 2004). Limited research focuses on early intervention approaches and techniques for young children with CP who are in the prelinguistic and preintentional stages of communication. For children in the prelinguistic and/or preintentional stages of development, interventions that target language acquisition directly may provide minimal benefit. For an illocutionary learner, intervention should emphasize expression through nonsymbolic forms. Intervention goals may include enhancing the child's rate of communication, use of specific communicative

means (e.g., gestures and vocal behaviors), and functions (e.g., requests, protests, comments, greetings, etc.) The most effective intervention strategies will enhance the child's use of intentional communication signals, building the foundation for later language acquisition (Ogletree & Pierce, 2010). It is important to target communicative forms that are within the child's zone of proximal development, which may not always be oral speech (Yoder & Warren, 2002).

Common recommendations for interactions with prelinguistic children are to train parents to contingently respond in a consistent way to intentional child communications. Previous research discusses the importance of maternal responsivity, suggesting that high responsivity supports intentional communication development (Yoder & Warren, 1998). Cress et al. (2013) suggests that parents may need additional support in recognizing pre-intentional behaviors. The goal of this section is to identify available research that supports early intervention approaches that may be adapted for this population.

Based on the child's specific communication needs, early intervention should focus on identifying the child's communication attempts, the communication partner's responsiveness, and organization of the environment to promote intentional communication. The goal of early intervention for young children with CP is to establish intentional communication that is efficient, less ambiguous, and successful (Snell & Loncke, 2002). Due to the nature of the disorder, successful communication exchanges are often difficult to develop. A lack of successful communication experience may diminish a child's internal motivation to act in a self-determined, and intentional manner. This may result in a pattern of dependency or learned helplessness (Horn & Kang, 2012). Intentional communication is learned through a pattern of partner interpretation, followed by partner action, which develops a child's understanding of a means-end relationship

and reinforces communication behaviors. The following discussion is not meant to be an exhaustive, but rather to provide examples of current approaches to early intervention methods for infants and toddlers, and the adaptations needed for children with CP.

INTERVENTION APPROACHES

Early intervention approaches for infants and toddlers with complex communication needs are geared toward naturalistic, child-centered approaches that are concentrated on training caregivers to act as language facilitators. Parent-training has become the gold standard of early intervention in the birth-to-three population. It is based on the transactional theory of development proposed by Sameroff and Chandler (1975), stating that both child and parent continuously influence and adapt to each other's behaviors. While there is a strong evidence base supporting this perspective on intervention with children with a variety of disabilities (including Autism, Down Syndrome, and language delay), there is a paucity of literature on parent-training interventions that includes adaptations specific to children with CP (Whittingham, Wee, & Boyd, 2010). Prelinguistic Milieu Teaching (PMT; Yoder & Warren, 1998) and The Hanen Program- It Takes Two to Talk (ITTT; Girolametto & Weitzman, 2007; Pepper & Weitzman, 2004) are two naturalistic, parent-training approaches to intervention that have been used to establish and enhance prelinguistic communication in young children with disabilities. These approaches will be discussed in terms of their efficacy for use with infants and toddlers with CP, in order to aid clinicians in the translation of current research to practice.

Hanen-It Takes Two to Talk

Previous research observing parent-child interactions of children with severe communication and motor impairments have determined that parents need support in detecting, interpreting and responding to their child's weak signals (Sandberg & Liliedahl, 2008). Many studies observing interactions of children with CP and their parents have observed the children playing passive roles in conversations, and parents playing more directive roles than parents of TD children (Pennington, Goldbart, & Marshall, 2004). One of the most widely used models for training parents as language facilitators is The Hanen Program- It Takes Two to Talk (ITTT; Girolametto & Weitzman, 2007; Pepper & Weitzman, 2004). ITTT is an indirect service delivery model, designed specifically for parents of young children identified as having delays in language. The primary objective of the program is to train parents to interact with their children in ways that influence their child's developmental progress in prelinguistic communication, vocabulary, and early word combinations.

Based on a naturalistic, child-centered model of training, parents are taught to identify the child's attempts to communicate and how to respond contingently. The program also trains parents to conduct play activities designed to encourage and enhance communication interactions. A child-centered approach is based on the theory that child-initiated activities and conversational topics are inherently more motivating and engaging than adult-directed interactions (Girolametto & Weitzman, 2007). Parents are encouraged to follow the child's lead, and wait for the child to initiate. Specific strategies used in the ITTT program are listed in Table 5.

Table 5. Hanen Program- It Takes Two to Talk intervention strategies.

Responsive Interaction Strategy	Purpose	Hanen Strategy
Child-oriented behaviors	Encourage the initiation of joint attention; increase opportunities for episodes of joint attention by attending to activities the child is already interested in.	"Observe, Wait and Listen (OWL)" "Get Face to Face" "Follow the Child's Lead"
Interaction-promoting strategies	Establish balanced turn-taking between caregiver and child.	"Match Your Turns to Your Child's Turns" "Cue your Child to Take a Turn" "Ask Questions that Keep the Conversation Going"
Language-modeling strategies	To enhance the child's receptive and expressive language abilities; Increase mean length of utterance	"Highlight Your Language" "Expand on What the Child Says" "Extend the Topic"

Giralometto & Weitzman, 2007; The Hanen Centre, 2013

Current research supporting use of Hanen has included late-talking toddlers and preschool children with varying developmental disabilities including Down Syndrome, Autism, and CP. Children ages 14- 64 months have been included in these studies, although the majority of the studies target use with 3-5 year olds. A Hanen Certified speech-language pathologist conducts training sessions for parents as well as video feedback sessions taped in the child's home. Outcomes of intervention using ITTT include: (a) Decreased directiveness and increased responsiveness in caregivers (Pennington et al., 2009; Tannock, Girolametto & Siegel, 1992), (b) Increased joint attention and turn-taking in children (Pennington et al., 2009),(c) Mother-child interactions are more balanced, long lasting, and frequent (Pennington et al., 2009;Tomasello & Farrar, 1986), (d) Positive change in child's behavior and overall family well being (The Hanen Centre, 2013) (e) Reduced mean length of utterance of adult, (f) Increase in vocabulary and MLU in children (Tannock & Girolametto, 1992).

Children with CP and severe communication disorders may be at risk for receiving less frequent responsive linguistic input from caregivers that facilitates communication and language development (Chen et al., 2007). Because the ITTT program focuses on responsive interaction training and reducing parent directiveness without directly targeting linguistic output, this approach could be effective and easily modified for parents of young children with CP. Partners could be taught why children with CP may have difficulties in producing quick and replicable movements for communication, how fast-paced conversation may hinder child initiation, and how to recognize a child's varying and idiosyncratic communication signals.

Pennington et al. (2009) investigated the effects of It Takes Two to Talk-the Hanen Program on interaction patterns of parents and their young children (ages 19-36 months) with CP. Previous research had not focused on using ITTT with children with wide-ranging motor impairments. Eleven children with motor impairment ranging from levels 2-5 on the *Gross Motor Function Classification System* (*GMFCS*; Palisano et al., 1997), and no vision or hearing impairment participated. The authors predicted that ITTT would result in mothers initiating less, using more responses and producing fewer requests for JA, objects and actions, and for known and unknown information. They also predicted an increase in child initiation and decreased child responses, including fewer "yes" "no" answers. Parent-child interaction was coded for a variety of pragmatic functions, including: request for joint attention, requests for objects or actions, request for information, request for clarification, provision of information, provision of clarification, acknowledgement, confirmation or denial, expression of self, behave, and unintelligible. Maternal input was coded and analyzed, calculating the caregiver's utterances per minute, words per minute, and complexity of their linguistic input (utterances per turn, MLU in morphemes).

After ITTT training, mothers initiated less, produced more responses, and produced fewer requests. These findings demonstrate that ITTT was associated with mothers becoming more responsive and less directive. Child outcomes included a higher production of initiations, as well as more requests and provision of more of information. The authors concluded that the children initiated more and exerted more control in interaction, and that these patterns were maintained after intervention ceased. There was no comparison between the amount of change in both parent and child outcomes, and the child's motor abilities. The authors did not provide the data for the individual children in terms of their motor impairment severity and outcomes.

An important limitation of Pennington et al.'s (2009) study is that the contents of ITTT were not adapted for the population. The authors note that it was possible that parents of children with severe motor impairment who may require AAC changed less than other parents. Additions to the program to cover AAC and to support its use with the most severely motor impaired children are needed.

Pennington and Noble (2010) explored the views of parents in the previous study by Pennington et al. (2009) on the usefulness and acceptability of ITTT with their children with motor disorders. Parents found the ITTT training videos in Pennington et al.'s (2009) study hard to relate to because the children in the videos did not have motor impairment. Little emphasis of the ITTT program was placed on AAC, though for some of the children it was a large part of their daily communication. Parents reported that the videotaping of their own interactions with their child helped them identify issues in interaction that needed attention, as well as changes in their own, as well as their child's communication styles. Parents also found feedback from other parents, as well as attending training with other parents whose children have similar needs, to be helpful. Parents recommended that the children of parents in the group should share similar

characteristics (i.e. motor impairment). In conclusion, parents recommended ITTT alongside direct therapy for their children.

Adaptations for children with CP

Adaptations for children with motor impairment may be needed in order for the ITTT program to be an effective intervention for children with CP. Because children with CP have difficulties in producing readable signals, parents may need to provide active help for their child when choosing activities, when developing meaning of a child's signals, and during communication breakdowns. This may involve parents' use of questions and commands; therefore, maternal directives are not inherently detrimental in this population. Following a child's lead for parents of children with CP may differ from a child without motor impairment. A typically developing child may crawl or walk across the room and begin to play with a toy of interest. In this case, the child's interest is obvious and easily interpreted. On the other hand, a child with CP may gaze across the room where several toys are located. There, the parent may need to bring the toys to the child, and then determine which the child was interested in. Holding up a selection of toys in the child's visual field, and determining the child's interest based on eye gaze may be the first step in following the child's lead. This strategy assumes that the child has sufficient head control and vision to use eye gaze to locate objects or events of interest. If the child does not have the visual or motor ability to locate objects or events on their own, it is up to the caregiver to bring objects to the child. While this is a more directive approach, providing options for the child will still allow an opportunity for the child to self-select an activity, and increase a caregiver's opportunity to follow their child's lead. Arranging the child's environment to provide opportunities for to initiate communication is of critical importance. This may involve positioning the child so that people and

objects are in their reach or visual field, as well as adapting toys so that the child has the opportunity to act upon them (for example using switches, handles, that are within the child's motor capacities).

Responsive Education/Prelinguistic Milieu Teaching

Modeled after the Hanen Program (Girolametto & Weitzman, 2007; Pepper & Weitzman, 2004), responsivity education (RE) is a parent-training method designed to support parents in interactions with their children (Warren et al., 2008). Prelinguistic Milieu Teaching (PMT) is a child-centered, play-based (naturalistic) incidental teaching method that explicitly teaches prelinguistic communication (Warren et al., 2008). Previous research observed the use of PMT with toddlers was effective in enhancing prelingusitic behaviors for children whose parents were highly responsive (Yoder & Warren, 1998). Hence, RE and PMT were combined into one approach termed RPMT or RE/PMT (Yoder & Warren, 2002), which has been studied with prelinguistic and preintentional toddlers with developmental disabilities (including Autism, Downs Syndrome, and Intellectual Disability) (Yoder & Warren, 1998; Yoder & Warren, 2001; Yoder & Warren 2002). Unfortunately, no current research exists supporting the use of RPMT with children with CP. Available research exploring the use of RPMT is discussed, as well as adaptations that would enable RPMT to be an appropriate intervention approach for children with CP.

PMT is derived from the principles of milieu teaching (MT; Warren & Bamabara,1989), which directly teaches words and early grammatical constructions in naturalistic conditions with reinforcers that are specific to the child. PMT differs from MT in that it targets preverbal and/or prelinguistic rather than verbal communicative acts (i.e. gestures, vocalizations, and coordinated eye gaze) (Fey et al., 2006). By arranging

the environment, the clinician creates opportunities for intentional communication behaviors. Similar to the Hanen approach, the clinician follows the child's lead, and contingently responds to the child's communicative behaviors. However, unlike the Hanen approach, PMT uses prompts and direct teaching methods to elicit specific child behaviors. Table 6 lists specific RE, MT, and PMT strategies.

Table 6. Components of Responsivity Education/ Prelinguistic Milieu Teaching.

Intervention Component	**Procedure**
Environmental Arrangement	Selecting materials of interest Arranging materials to promote requests Mediating the environment Engaging in activities with the child
Responsive Interaction strategies	Following the child's lead Balancing turns Maintaining the child's topic Modeling linguistically and topically related language Matching the child's complexity level Expanding and repeating the child's utterances Responding communicatively to the child's verbal and nonverbal communication
Pre-linguisitic Milieu Teaching	Praise Prompts Models Expansions
Milieu Teaching techniques Modeling	Model Mand-model Time delay Incidental teaching

Hancock & Kaiser, 2006; Warren et al., 2006.

Yoder and Warren (1998) tested whether maternal responsivity would affect the extent to which PMT facilitated intentional communication behaviors in comparison to a responsive education group (i.e. Responsive Small Group, RSG). Sixty toddlers (age range 17-36 months) who had developmental delays (i.e. Downs Syndrome, prematurity, PDD-NOS, Fetal Alcohol Syndrome, & other idiopathic etiologies) and their parents were randomly assigned to one of the two prelinguistic interventions. Children with vision, hearing, and motor impairment were excluded from the study. Pre- and post-treatment preintentional and intentional communication behaviors, as well as the degree of maternal responsivity were evaluated during experimenter-child interaction (ECX), mother-child interaction (MCX) and during administration of the CSBS (Wetherby & Prizant, 1993). Preintentional communication behaviors evaluated included: unconventional gesture or vocalizations and facial expressions without coordinated attention. Intentional communication behaviors evaluated and targeted included: unconventional and conventional gestures and vocalizations with coordinated attention to the adult. PMT targeted the child's use of proto-imperatives (i.e. requests for objects or actions) through play routines and turn-taking sequences (e.g. rolling a ball, peek-a-boo). Proto-declaratives (i.e. commenting, showing, etc.) were targeted once the child frequently used proto-imperatives.

Results showed treatment effects varied as a function of pre-treatment maternal responsivity. Children whose mothers responded at high rates to their child's communicative acts pre-treatment benefitted more from PMT than RSG. Children whose mothers had low levels of responsivity (i.e. mothers who responded to less than 39% of child's communicative behaviors) benefited more from RSG than PMT. Results of this study observed significantly more intentional communication acts post-treatment in both the PMT and RSG groups, depending on the level of pre-treatment maternal responsivity.

Based on their previous (1998) study, Yoder and Warren (2002) tested the efficacy of the combined use of RE with PMT (abbreviated RE/PMT or RPMT) on the development of requests and comments in 39 prelinguistic toddlers with intellectual disabilities (including one child with mild CP). Requests were described as the child's use of conventional or unconventional gestures or vocalizations with coordinated attention to an adult for the purpose of requesting an object or action. Comments referred to the child's use of conventional or unconventional gestures or vocalizations for the purpose of sharing interest or positive affect about an object or event. Results suggest that RPMT accelerated growth in comments and lexical density if the child began treatment with low frequency comments. The authors suggest that for children with already high frequency of comments involving vocalizations, MT that directly targets linguistic output may be more appropriate.

Fey et al. (2006) modified the RPMT intervention approach to broaden its effects across participants. Participants in their (2006) study included 51 children between the ages of 24 and 33 months, with a range of developmental delays who had limited use of intentional communication acts as measured by the CSBS (Wetherby & Prizant, 1993) and the MCDI (Fenson et al., 1991). Again, none of the children had the etiology of CP, and children with vision and hearing loss, as well as those without adequate upper body motor skills to perform gestures were excluded. In Yoder and Warren's (2002) study, interventionists required children to combine gestures or vocalization with gaze shifts between the child's object of attention and the adult. Fey et al. (2006) hypothesized that this may have been too difficult for children who have difficulty requesting. Therefore, gaze shift alone was accepted as an approximation of a request, and requirements increased until they eventually equaled those used by Yoder and Warren (2002). Another modification to RPMT was a change in clinician response to the child's vocalization. In

Yoder and Warren (2002), clinicians responded to vocalizations by imitating the child's behavior. Fey et al. (2006) modified clinician response by linguistically mapping the child's behavior, and complying with the child's request. For example, in response to a child's production of "didi" for "juice", instead of repeating "didi", the clinician responded by saying "juice" and provided the child with a juice box. Results demonstrated that six months of RPMT lead to significant gains in children's rates of intentional communication acts. Intentionality was based on the child's combination of either a vocalization or a gesture (or both) with gaze alteration between the object/event and the adult's face. Specifically RPMT lead to increases in the child's proto-imperatives and proto-declaratives measured by the CSBS, in comparison to the control group.

Adaptations for children with CP

While none of the available research included children with moderate-severe physical impairment, or perceptual impairment, RPMT may be an appropriate intervention approach for young children with CP who are in a pre-intentional and/or prelinguistic stage of development. PMT is designed for children who have not yet developed symbolic communication, and focuses on explicitly teaching prelinguistic behaviors such as joint attention, vocalizations, and eye gaze. Responsivity education for parents of children with CP would assist parents in understanding and appropriately responding to their child's communication acts. For children with CP who have severe motor deficits, muscle tone, breathing rate, and body movement may necessitate maternal responses, in addition to vocalizations, gestures and eye gaze observed in the previous studies. Depending on the child's motor abilities, PMT may be adapted to explicitly teach and reinforce intentional behaviors that are in the child's zone of proximal development. Appropriate request behaviors for a child with CP may include fixed eye

gaze with or without body movement or vocalizations. In the next section, including the use of augmentative and alternative communication into early intervention approaches is discussed.

Alternative and Augmentative Communication

Children with CP are excellent candidates for augmentative and alternative communication (AAC) even in the prelinguistic stage of development. The overarching goal of AAC is to create mutually rewarding communication actions for the child and their communication partner. Due to the difficulty partners have at interpreting the intent or purpose of the child's behaviors (e.g. facial expressions, body movements, eye gaze), AAC may be used to not only establish, but also enhance a child's prelinguistic behaviors. Early AAC intervention should incorporate the child's current communication and linguistic repertoire, and strive to expand it. In view of the ICF framework (WHO, 2001), the goal of AAC intervention is to provide a system of communication that will enhance communicative interactions and participation in society (Sigafoos, Drasgow, & Schlosser, 2003).

Communication intervention needs of beginning AAC communicators who are in the prelinguistic stage of communication development are scarcely represented in existing empirical literature (Romski et al., 2002). Many professionals, as well as parents believe that AAC should be the last resort, to be tried only after all other interventions have failed, and oral speech is not foreseen (Romski, Sevcik, & Forrest 2001). Postponement in the therapeutic implementation of AAC with young children is often due to concerns that AAC may interfere with a child's verbal expressive development. However, current research asserts that AAC intervention may facilitate speech development (Branson & Demchak, 2009; Drager, Light, & McNaughton, 2010),

although the focus of this section is on the use of AAC for prelinguistic functions, and not for meaning based output.

It is often assumed that in order to receive AAC intervention, children need to demonstrate sufficient symbolic understanding. Current literature supports the use of AAC for children who are in the presymbolic and even pre-intentional stages of development (Ogletree, 2010; Dugan, Campbell, & Wilcox, 2006). AAC systems for beginning communicators typically focus on the acquisition of early pragmatic functions such as requesting and rejecting, which can greatly impact a child's participation in and control of their environment. Typically developing children primarily rely on gestures and pre-verbal behaviors to communicate until about 12-13 months of age when oral speech is increasingly used to communicate (Iverson & Goldin-Meadow, 2005). AAC interventions including gestures, devices, and switches, may be used as tools to develop alternative prelinguistic skills for children with motor impairment. Regardless of whether the child will eventually use oral speech, prelinguistic communication skills are necessary in order for later language development (Bates et al., 1975; Reinhartsen, 2000). The critical factor for CP children is adaptation to their motor, perceptual, and cognitive capabilities.

Early access to AAC use may enhance interactions between the child and his or her communication partners during the critical period of language acquisition (i.e. the first three years of life) (Branson & Demchak, 2009). By making communication signals recognizable to his or her caregiver, opportunities for successful communication exchanges will increase. In turn, caregivers are more likely to respond in a contingent and consistent manner, which is fundamental to the development of intentional communication (Harwood et al., 2002). Empirical literature specifically addressing AAC use with infants and toddlers is limited. Most of the available research focuses on older

children with the goal of requiring meaning based output. Branson and Demchak (2009) systematically reviewed the available literature focusing on AAC use with children in the birth to 3-year population. Their findings included seven single-subject and five group design studies that included a total of 190 participants, five of which had a diagnosis of CP and 28 had "multiple disabilities" (e.g. CP plus sensory impairment). The forms of AAC used included manual signs, picture symbols, voice output devices, gestures, eye gaze, vocalizations, and body movements. Outcomes of the review rated 7 of the 12 studies as providing conclusive evidence with outcomes reporting improved communication for 97% of the 190 total participants. Only 71% of those participants were enrolled in studies providing conclusive evidence. These studies supported the use of unaided AAC as well as low-technology devices and voice output systems. These forms of AAC were used to communicate a variety of functions including requesting, commenting, choice making, and protesting. While Branson and Demchak's (2009) review provides support for the use of a variety of AAC forms, it does not provide knowledge of the benefits of one form of AAC compared to another with respect to specific populations. The following is a brief overview of the various forms of AAC and their suggested use and benefits for infants and toddlers with CP.

Unaided AAC

Intervention using AAC in children who do not use or understand symbols and the rules of language focuses on enhancing the quality of the child's nonsymbolic expressions, establishing communicative intent, and lastly, expanding the child's repertoire to include symbolic communication. Intervention using AAC may include unaided modes, which rely solely on the child's body, with no external tools or equipment (e.g. eye gaze, facial expression, gestures, sign, and body movements). A

child's ability to successfully use unaided AAC systems depends on the child's motor, perceptual, and cognitive abilities. For example, a child who has spastic hemiplegic CP who has sufficient motor control of one arm, good head and neck control, and possibly the ability to vocalize vowel sounds may benefit from unaided AAC systems. These could include manual sign and body movements and may be combined with vocalizations and eye gaze.

Aided AAC

Aided AAC systems involve external tools or equipment such as picture boards, communication books, electronic speech generating devices, head switches, etc. One of the benefits to using aided AAC devices is that they are less restricted relative to the child's motor abilities, allowing a larger repertoire of signals to be communicated for a wider variety of functions. For example, a communication board or speech generating device may contain a larger number of vocabulary items than what a child can produce by manually signing. Aided AAC devices may also allow a child to produce communicative signals that are interpreted by unfamiliar communication partners more easily. For example, a child may produce an unconventional, though consistent, hand sign signaling he wants a drink. Another child may simply point to a communication board displaying a picture symbol for drink. Though both signals may be produced consistently, one (the picture symbol) may be more conventional and easily understood.

Disadvantages to using aided AAC systems include the reliance on the availability of the device in order to communicate and the presence of the communication partner to interpret the signal, and the complexity of various systems. For example, while strapping a child into a car seat, the child may want to communicate that they are in pain. A child using manual sign would be able to communicate this to their partner,

whereas a child relying on a picture symbol may not have the communication board available to do so. Also, if a caregiver is not positioned correctly (i.e. has their back to the child) while the child is pointing to a communication board, the signal will be lost. On the other hand, if the child was taught to vocalize for attention, or perform a body movement, the partner's attention may be more easily captured.

The inclusion of aided AAC systems in communicative exchanges may place additional demands on a child's attention and memory (Beningno, Bennett, McCarthy, & Smith, 2012). For example, a triadic interaction involves interaction between the child, communication partner, and object. With the addition of an aided AAC device during a triadic interaction such as book reading, the complexity of the interaction increases to a quadratic interaction (Smith, McCarthy, & Benigno, 2009). Children with CP may have the additional complication of visual impairment, making gaze shifts between the device, the partner, and the object, difficult. Benigno et al. (2012) discuss strategies to minimize the demands inherent to the use of AAC. Strategies include using AAC in direct line of sight of the child, or pairing the adult's eye gaze with the AAC system. In order to reduce the complexity of the interaction, specific adaptations according to the motor, perceptual, and attention abilities of the child may be needed.

Determining whether to use aided or unaided devices is ultimately dependent on the child's abilities, the communication partners comfort level, and the structure of the communication environments the child must master. The appropriateness of an AAC system therefore, is specific to each child. A combination of both aided and unaided communication strategies, if possible, is always most beneficial. The goal of AAC interventions for children with CP is to make communication behaviors more consistent, and less ambiguous, so that communication partners may consistently interpret and respond to them.

INTERVENTION CONCLUSION

Given their impairments in movement, as well as possible impairments in perception and cognition, children with CP are at a high risk for impairment in communication development. The goal of early intervention for infants and toddlers with CP is to promote development of intentional communicative behaviors by any means possible, and to motivate the child to initiate communication in order to avoid a common pattern of learned helplessness (Basil, 1992). Learning how to make choices, and how to make those choices intelligible to others are critical milestones toward achieving the valued outcome of self-determination (Horn & Kang, 2012). Intervention needs to focus on the child, their communication partners, and their salient environment, in order to establish a communication interaction that is mutually rewarding to both the child and their partners. When working with infants and toddlers, naturalistic intervention and parent involvement are considered optimal. A collaborative team that includes a variety of professionals as well as family members is key to effective intervention. Because of the idiosyncratic and unconventional nature of the communication signals often seen in children with CP, intervention for young children with CP may also require direct teaching of specific behaviors.

The desired outcomes of intervention include: both child and environmental components. For the child, more socially appropriate and readable communicative forms, broadening of the child's range of communicative functions; improvement in repairing communication breakdowns. Relative to the child's environment, more consistent interpretation of the child's communicative forms and improvement of characteristics of the environment to support further development of communication are critical components.

Overall, there is limited empirical literature describing effective intervention approaches for young children with CP that focuses on establishing and enhancing prelinguistic communication behaviors. Effective approaches to intervention that have targeted prelinguistic communication (i.e. Hanen and RPMT), as well as approaches that are most often used with children with physical impairment (i.e. AAC) have been discussed in terms of their possibilities for use with infants and toddlers with Cp.

There are many limitations in the current literature encompassing intervention approaches for infants and toddlers with CP. It may be argued whether research findings from studies of early interaction between children who are typically developing and their caregivers are valid for planning and implementing intervention for children with CP. Motor development in children with CP differs from that of TD children. Therefore, it may also be assumed that the development of communication in the form of joint attention, eye gaze, gesture, and vocalizations will differ. Hence, intervention strategies based in theory on the zone of proximal development may not be effective strategies for children follow a different pattern of development. The majority of the studies reviewed do not include children with severe motor impairment who do not have use of their upper extremities and are therefore biased against children with more severe forms of CP.

Chapter 5: Discussion

Clinical Implications

Children with CP are unique in their development of motor, perceptual, and communicative milestones. Impairments in movement, perception, and cognition have direct and indirect effects on the development of adequate intentional prelinguistic communication to support development of a linguistic communication system. When working with infants and toddlers with CP, intentional communicative behaviors may be difficult to interpret and respond to due to a limited repertoire of behaviors, and the inability to produce behaviors in a consistent manner. As a result, CP children may not be motivated to produce goal-directed behaviors consistently, placing them at a high risk for impairment in the development of intentional communication, and a pattern of learned helplessness (Basil, 1992). Intervention focusing on meaning based linguistic output is not appropriate until a child has developed the ability to communicate intentionally through prelinguistic means.

Overview of developmental milestones

Developmental milestones in the areas of motor, perception, and prelinguistic communication were outlined for both typically developing children, as well as children with CP. Impairments in motor and perceptual abilities were shown to have negative impacts on the development of prelinguistic communication means including the development of joint attention and gesture. Current literature examining interaction patterns of young children with CP and their caregivers was found to differ greatly from that of their TD peers. Children with CP often have deficits in turn-taking abilities, often displaying a passive involvement in interactions with their caregivers. They are often less likely to initiate communication, and are often placed in a highly responsive role. Parents

may play a more directive role during conversations, taking more turns and asking a high number of yes/no questions. Difficulties responding to a child's communicative behaviors in consistent are a natural result of interaction with a child whose communicative signals are often idiosyncratic. An overview of the development of early communicative behaviors in both TD and children with CP has highlighted specific areas of importance to consider when assessing and providing intervention for infants and toddlers with CP.

Overview of assessment

Areas of assessment identified as important in evaluating infants and toddlers with CP include: motor, perception, joint attention, gesture, and caregiver-child interaction patterns. A variety of assessment methods are employed in the assessment of infants and toddlers with CP including: standardized assessment measures, rating scales, checklists, parent questionnaires and structured interviews, informal clinical observations and structured research protocols. However, limited research provides evidence for the effectiveness of use of these assessment measures for infants and toddlers with CP. Adaptations to accommodate a child's motor and perceptual needs have been highlighted. Measures that provide a more descriptive picture of the child's potentially communicative behaviors have been outlined, and may provide the most comprehensive assessment of a child's abilities. In order to understand the extent and range of function and disability of a child with CP, multiple assessment measures may be needed. The goal of assessment is describe all levels of the ICF framework including: impairments of body structure and function, activity limitations and participation restrictions, as well as personal and environmental barriers. A comprehensive view of these levels will aid the clinician in developing appropriate goals and a plan for intervention.

Overview of intervention

Appropriate goals for infants and toddlers with CP include: socially appropriate and readable communicative forms that may be produced consistently. Goals for the child's communication partners include improvement in producing consistent interpretation of and contingent responses to the child's communicative forms.

Indirect methods of communication intervention in the form of caregiver training, as well as direct methods that explicitly teach prelinguistic behaviors have been discussed in terms of their appropriateness for infants and toddlers with CP. Intervention using the Hanen Program-*It Takes Two to Talk* (Girolametto & Weitzman, 2006), have shown positive changes in interaction patterns of parents and their children with CP who had moderate-severe motor impairments. Following ITTT training, children initiated more, and mothers were observed to be more responsive and less directive during interactions.

Prelinguistic milieu teaching (PMT) (Yoder & Warren, 1998) unlike ITTT, directly teaches prelinguistic communication behaviors to children with delays in communication. Previous research supported the use of PMT with toddlers whose parents were already highly responsive during interactions with their children (Yoder & Warren 1998). Hence, Responsive Education (RE) was combined with PMT in order to incorporate both direct and indirect methods of intervention. No studies were found supporting the use of RPMT with children with moderate-severe physical impairment; however, suggested adaptations were provided in order to support the use of RPMT with infants and toddlers with CP.

Improvements of characteristics of the environment are also a critical aspect of intervention with children with severe motor impairment. Many children with CP are not able to successfully control their environments, which places them at a high risk for developing the behaviors and attitudes associated with learned helplessness (Seligman,

1975; Beukelman & Mirenda, 1998). Early intervention should aim to construct situations to teach children that they can control people and objects in their environment. This may involve providing the child with AAC, including adapted toys, that allows the child to interact with their environment (Beukelman & Mirenda, 1998). AAC is also discussed as a means of enhancing prelinguistic behaviors through aided and unaided methods. Early access to AAC methods may enhance a child's prelinguistic communication behaviors by making those behaviors recognizable to the communication partner who, in turn, can respond to and reinforce the behaviors (Branson & Demchak, 2009).

By adapting these approaches to meet the child's physical, perceptual, as well as cognitive needs, direct, indirect, and augmentative and alternative approaches to intervention may be appropriate interventions for teaching and enhancing prelinguistic communication skills to infants and toddlers with CP.

FUTURE RESEARCH

This review draws conclusions from available research on typically developing children, as well as children with CP and other developmental delays. Due to the paucity of empirical studies on effective approaches to assessment and intervention in infants and toddlers with CP, many assumptions were made concerning the development of prelinguistic communication, as well as appropriate adaptations for assessment and intervention. Further research providing evidence based practice for the use of adapted assessment measures and protocols, as well as effective intervention strategies needs to include infants and toddlers with CP who have severe motor impairments (i.e. limited use of upper motor extremities, including limited head support). Children with co-occurring perceptual and cognitive impairments need to be included in empirical research as well.

More rigorous examination of the development of prelinguistic communication abilities in children with CP is also needed.

Appendix

Table A1. Summary of criteria for the birth-2 and 2-4 years age bands of the Gross Motor Function Classification System-Edited and Revised.

Before 2nd Birthday	
Level I	Infants are able to sit on the floor with both hands free to manipulate objects. Infants are able to crawl on hands and knees. Infants walk before 2 years of age without an assistive mobility device.
Level II	Infants are able to sit on the floor, but may need to use their hands for support to maintain balance. Infants creep on their stomach or crawl on hands and knees. Infants may pull to stand and take steps holding on to furniture.
Level III	Infants are able to sit on the floor when their lower back is supported. Infants roll and creep forward on their stomachs.
Level IV	Infants have head control but trunk support is required in order to sit on the floor. Infants can roll from stomach to back, and may roll from their back to their stomach.
Level V	Infant has limited voluntary control of movement. Infants are unable to control antigravity head and trunk postures while on their stomach, and while sitting. Infants require adult assistance to roll.
Between 2nd and 4th Birthday	
Level I	Children sit on the floor with both hands free and walk without the need for any assistive mobility device.
Level II	Children may sit on the floor with the support of their hands. Children crawl on hands and knees with a reciprocal pattern, and may walk using an assistive mobility device.
Level III	Children may sit on the floor, often requiring adult assistance in positioning. Children creep on their stomach or crawl on hands and knees (often without reciprocal leg movements) in order to move independently. Children may walk short distances using an assistive mobility device such as a walker, with adult assistance for steering and turning.
Level IV	Children frequently require adaptive equipment for sitting and standing. Self-mobility for short distances (within a room) is achieved through rolling, creeping on stomach, or crawling on hands and knees without reciprocal leg movement.
Level V	Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. Children have no means of independent mobility and require an adult for transporting. Some children achieve self-mobility using a power wheelchair with extensive adaptations.

Palisano, Rosenbaum, Bartlett & Ivingston, 2009.

Table A2. Common measures used to assess early development.

Test	Age	Purpose	Type of Test	Format	Domains Assessed
Vineland -II	Birth to 90 years	Measure of personal and social sufficiency in everyday activities.	NRT	Survey through semi-structured interview, Parent/caregiver rating, Teacher Rating, Expanded interview	Communication (receptive, expressive, written) daily living skills (personal, domestic, community), socialization (interpersonal relationships, play and leisure time, coping skills), motor (fine and gross) and maladaptive behavior index
MSEL	Birth to 68 months	Comprehensive measure of cognitive functioning.	NRT	Observation during structured activities	Gross Motor, Visual Reception, Fine Motor, Expressive Language, and Receptive Language
CDI	1;3- 6;0	Comprehensive set of parent report instruments to assess communication and language abilities in young children.	CRT	Parent questionnaire and interview	Social, self-help, gross motor, fine motor, expressive language, language comprehension, letters, numbers, and general development.
CSBS-DP	0;6-2;0	Screening and evaluation of communicative and symbolic abilities measured by a set of prelinguistic indicators.	NRT	Parent report: Infant-toddler checklist, caregiver questionnaire, caregiver rating-perception of behavior sample Direct Interaction & Behavioral Observation: Behavior Sample	Social Composite: Emotion & Eye Gaze, communication (including joint attention), gestures Speech Composite: Sounds, words Symbolic Composite: Understanding, Object Use
REEL-3	Birth- 3 years	Identify infants and toddlers who have language impairments or other disabilities that affect language development.	NRT	Caregiver Interview	Receptive Language, Expressive Language, Inventory of Vocabulary Words
IPCA	N/A	Identify potential communicative acts of children with severe communication impairment associated with a range of developmental and physical disabilities.	Research Protocol	Parent Interview	53 questions asking informants to indicate how the child communicates 10 distinct pragmatic functions.
Bayley-III	1-42 months	Identify children with developmental delay in communication and provide information for intervention planning.	NRT	Observation of the child, parent/caregiver report form, behavior observation inventory	Cognitive, expressive language(babbling, gesturing, joint referencing, turn taking, vocabulary), receptive language motor (gross/fine) development. Questionnaires: social-emotional and behavioral.
BDI-2	Birth- 7;11	Screens and evaluates early childhood developmental milestones.	NRT	Observation of the child, parent/caregiver interview, standardized tasks	1) Adaptive: Self-care, personal responsibility; 2) Personal-Social: Adult interaction, peer interaction, self-concept and social role; 3) Communication: Receptive/Expressive; 4) Motor: Gross, fine, and perceptual motor; 5) Cognitive: Attention and memory, reasoning and academic skills, perception and concepts
Rossetti ITLS	Birth- 3 years	Identifies preverbal and verbal language development problems and provides essential information for early intervention.	CRT	Behaviors can be directly elicited from the child, directly observed, or reported by the caregiver.	Interaction-Attachment, Pragmatics, Gesture, Play, Language Comprehension, and Language Expression.

Vineland Adaptive Behavior Scale-Second Edition (Vineland-II) (Sparrow & Cicchetti, 2005); MacArthur-Bates Communication Development Inventory (CDI) (Fenson et al., 1991); Communication and Symbolic Behavior Scales Developmental Profile (CSBS-DP) (Wetherby & Prizant, 2002); Receptive-Expressive Emergent Language Scale 3rd Edition (REEL-3) (Bzoch, League, & Brown, 2003); Inventory of Potential Communicative Acts (IPCA) (Sigafoos et al., 2000); Bayley Scales of Infant and Toddler Development, 3rd Edition (Bayley-III) (Bayley, 2006); Battelle Developmental Inventory, 2nd Edition (BDI-2) (Newborg, 2005); Rossetti Infant-Toddler Language Scale (ITLS) (Rossetti, 1990).

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